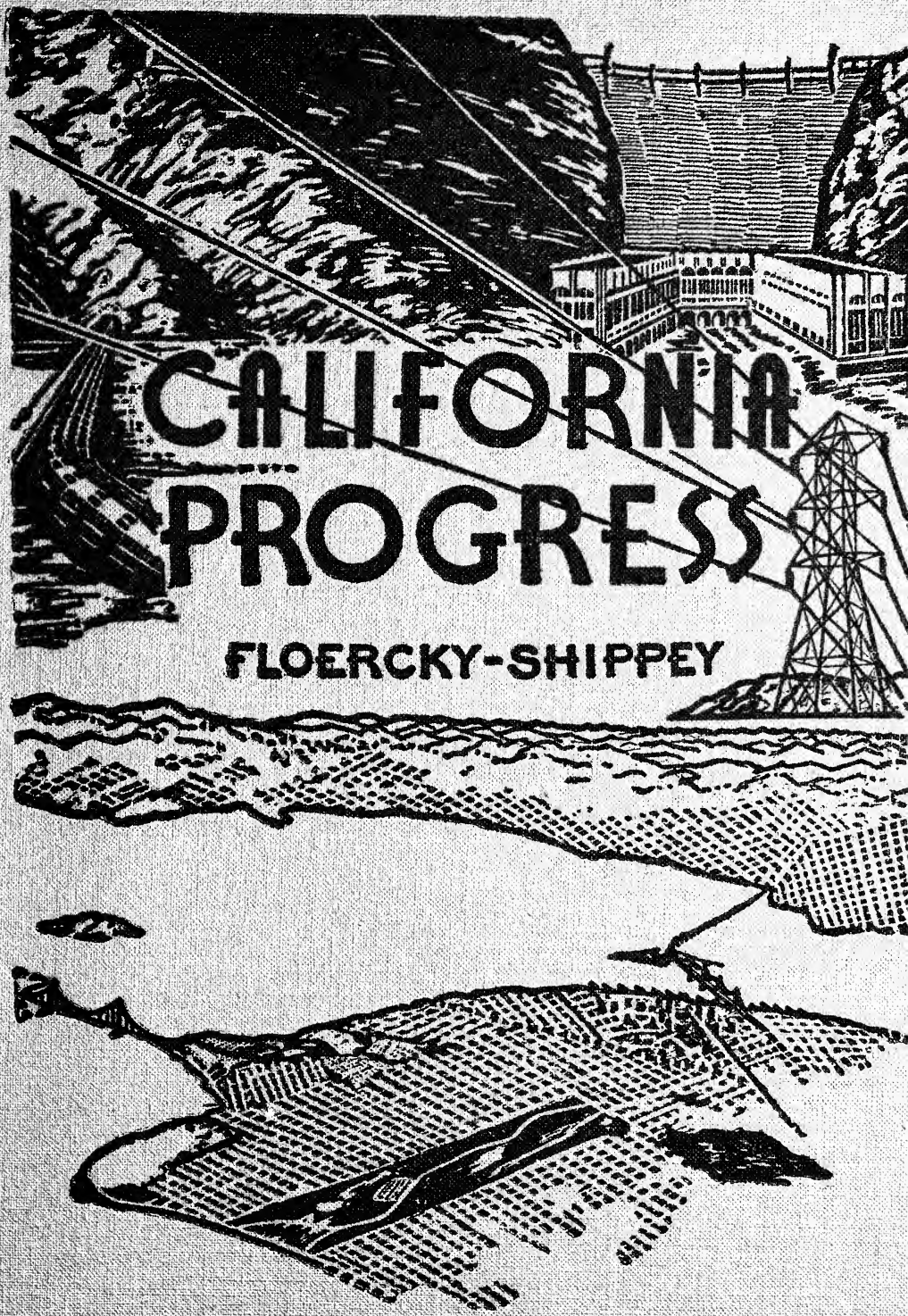
CALIFORNIA
PROGRESS
FLOERCKY-SHIPPEY

California Progress

Great Projects Which Overcome Handicaps of the Past and Prepare the Way for a Greater Future

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The California Spirit

At the present time, California is becoming America's show window of engineering genius. Things are being done here which arouse the wonder and admiration of the world. Handicaps which nature put on certain parts of the state are being removed. Things which the people of other lands and other times have meekly endured, seeing no hope of bettering their condition, are being overcome.

Nowhere else in the world have bridges rivaling the great bridges over the Golden Gate and San Francisco Bay been built. Nowhere else has a dam rivaling Boulder Dam been constructed. Nowhere else has a water plan for an entire state been worked out to include all problems of water supply development, control, and use—providing for flood prevention in one area and drought relief in another. Such major projects as Boulder Dam, the All American Canal, the Metropolitan Water District of Southern California, the Los Angeles County Flood Control District, the Hetch Hetchy Project for San Francisco, and the Central Valley Project are designed to solve all of California's important flood and drought problems and provide for improvement of navigation on our inland water ways. At the same time, the electric energy generated by Boulder Dam water and Kennett Dam water will make it easier for the people of rural districts as well as those in towns and cities to enjoy all the comforts and conveniences which electricity can give to the modern world.

It was southern California's crying need for water which made Boulder Dam necessary and it was the determined efforts of Californians which made it possible. The dam itself is not in California but the greater part of the water from it, and the electric current made by use of that water, will serve this state. So it fairly may be looked on as a California achievement. The other projects are wholly within this state.

No doubt the building of Boulder Dam will inspire other great projects of the kind, adding to the progress and prosperity of the world. No doubt the Central Valley Project will awaken other states and other nations to the possibility of working out better and more complete plans for water distribution and flood control than they have ever had before. No doubt the great bridges, the most challenging and dramatic construction achievements of human history, will be examples to builders throughout the world.

The pyramids of Egypt are classed among the wonders of the world. They deserve to be ranked among the great achievements of all time, but the science of engineering has progressed so far that their construction seems simple compared to that of the great San Francisco bridges.

It is no new thing for Californians to do what other people considered impossible. De Anza achieved the "impossible" when he blazed the first trails across California mountains. Kearny and his men achieved the "impossible" when they marched across trackless mountains and wastes from Santa Fe and still found strength to conquer a strange and hostile land. The pioneers achieved the "impossible" when they came in covered wagons across the high Sierra. The people of Los Angeles achieved it

when, in 1905, they reached out 250 miles for the water their city needed. In short, so far the California spirit has found a way to do all the "impossible" things which became necessary. When anything has to be done, Californians have found a way to do it.

Every Californian has a right to be proud of that spirit, and to share in it. It belongs to all of us. While we cherish it we shall go forward to greater things. So long as we hold to that spirit the progress of California will be rapid and helpful. It will provide room, comfort, and prosperity for millions of people. It will make better use of the natural resources of the state than any other state or any other country has ever made of its resources.

The great public works now being built are proof of what can be achieved by those who learn how to do useful things and have the courage to work steadily toward success. They also are reminders that we have reached the age in which sincere study is more necessary than ever it was before. Great dams and bridges can not be built by those who have not learned to study; nor can they build or operate clipper airplanes. Thirty years ago there were many fields of endeavor in which uneducated or half-educated people could succeed. Now there are very few.

Therefore the California spirit and the amazing progress now resulting from it are and should be of vital interest to you students who, in a few years, will be called on to do your part in the forward march of California.

Now is the time to prepare.

BOULDER DAM

AND THE

COLORADO RIVER AQUEDUCT

President Franklin Roosevelt delivering the principal address at the dedication ceremony of Boulder Dam

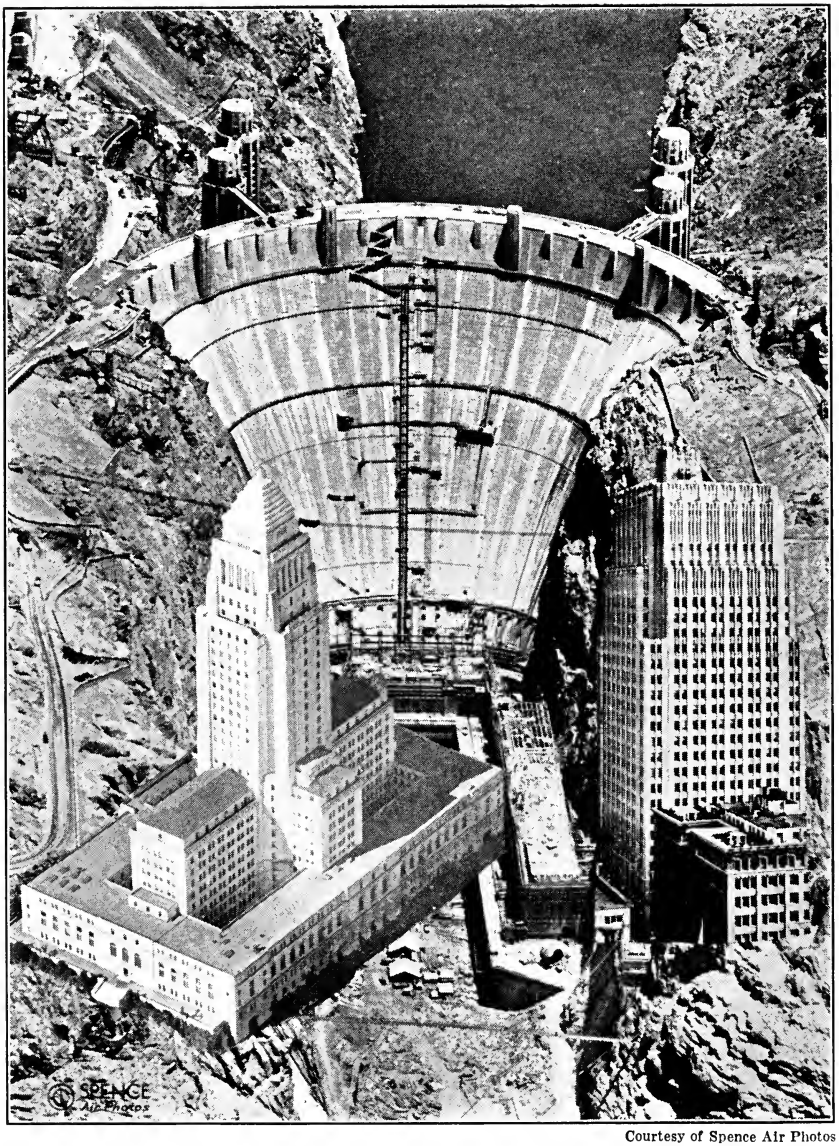
Boulder Dam and the Colorado River Aqueduct

The Great Basin

The Great Basin, shown on the map below, lies between the Sierra Nevada and Rocky Mountains. It reaches into Oregon and Idaho on the north, and to Mexico on the south, and its edges slope upward to the highest ridges of the surrounding mountains.

The Great Basin is the most desolate and least populated part of the entire United States. The reason for this is summed up in three words—lack of water. Man cannot exist without water, and here is a region which receives an average of less than one inch of moisture per month throughout the year. In places, at the lower end of the Basin, the rainfall amounts to five inches or less for the entire year.

Map of Western States showing the Great Basin



Courtesy of Spence Air Photos

Neither the Los Angeles City Hall, 464 feet high, the tallest building in southern California, nor the San Francisco Telephone Company Building, the tallest in northern California, compare in width or height with Boulder Dam, the greatest structure ever built by man.

To the west of the Great Basin, we see how the water from the Sierra Nevada flows to the sea, through San Francisco Bay. On the right, or eastern side of the Great Basin, the rain and melted snows from the mighty Rockies form the Colorado River, which flows southwesterly to the Pacific Ocean through the Gulf of California. Here is the river which drains most of the water from the greatest mountains in the country. In the succeeding pages we shall see how it has been harnessed and its waters used for the progress of mankind.

A Dam Which Will Change the Entire Southwest

Engineers tell us that Boulder Dam on the Colorado River will be greater in size and weight than the greatest of the pyramids of Egypt; that it will form a lake as long as from Los Angeles to the Mexican border; that it will supply four times as much electricity as is generated on the American side of Niagara Falls; that the lake will hold five thousand times as many gallons of water as there are men, women, and children in the whole world; and many other facts and figures which are so staggering that it is hard for us to understand them.

The thing which every American, and especially every Californian, should understand is that Boulder Dam is a great monument of progress. It is a shield to protect the forward march of civilization. It is proof that man can overcome obstacles which have buried other civilizations under desert sands, and that the time-worn saying, "history repeats," need not be true.

Indeed, Boulder Dam is a proof that there are two kinds of people in the world, those who meekly accept life as it is and those who have the courage and will to change it for the better.

It is a fact that much of the American Southwest, including southern California, is, or has been, desert. Now and then someone who lacks faith and courage tells us that in time it will go back to desert. Such people say that when the population becomes greater than its water supply can sustain it will vanish from the earth as did ancient Babylon. Some historians say that in the time of its glory Babylon was a greater city than Los Angeles, the largest city in southern California. History, they say, will repeat.

There are other people who tell us there is nothing new under the sun. Californians know, or should know, that the progress of the world has been held back greatly by people who believe in old sayings instead of using their own hands and brains. They know that there are plenty of new things under the sun. They do not believe that they are "tampering with nature" when they see that nature has placed within their reach the very things they need, and reach out for those things. Modern science does not look on a flood as a thing which cannot be avoided. Instead of building an ark to float away on the flood, modern science takes steps to prevent it and store the water it would waste for the needs of mankind.

Boulder Dam Built Primarily to Meet the Needs of California

Boulder Dam is not in California. It is in Black Canyon, with one of its massive shoulders resting on the rugged cliffs of Arizona and the other on the rock walls of the Nevada side of the canyon. It was because of the needs of California that it was built. Although the city of Los Angeles already had built a conduit to the high Sierra, two hundred and fifty miles away, to bring down water, it became apparent that before many years

it would need more water. The needs of other southern California cities, the growing irrigation needs of the Imperial Valley and Coachella Valley, and the fact that the Colorado River was a yearly flood menace to southern California ranchers, finally led the United States government to undertake this gigantic project which, including the aqueduct, calls for a total expenditure of some three hundred million dollars.

River of Good Guidance in 1540, and Today

When Captain Hernando Alarcon discovered the mouth of the Colorado River in 1540, he named it the River of Good Guidance, believing that it would guide him to the fabled Seven Golden Cities of Cibola. If any modern school boy were told that out in a desert where only scattered bands of half-starved Indians could live were seven beautiful cities built all of gold, with streets paved with gold, he would not believe it. But the great conquistadores, who came to New Spain with Hernando Cortez, were so eager for new riches that they would believe almost any story. Like some people today, they never knew when they had enough. The conquest of Mexico had given them vast treasures of gold and silver. Yet Cortez wasted fortunes on expeditions to find the fabled Seven Cities, and then Mendoza, who followed him as Viceroy of New Spain, continued the effort. Mendoza sent a land party headed by Francisco Coronado, for whom Coronado Island is named, and also an expedition by sea under command of Alarcon.

Alarcon sailed up the Gulf of California, believing that Lower California was an island. The geographers of that day showed it as an island. He was much annoyed when he found that the maps which had guided him were incorrect. But when

he discovered a river flowing into the gulf—a river big enough to accommodate sailing vessels in those days—he was delighted.

He named the stream the River of Good Guidance, and gayly started to sail up it. But he could not sail far. For the Colorado River carries more silt than any other river except the Nile and, though that was close to four hundred years ago, the silt had been coming down for perhaps a million years, and mud banks were so numerous that soon his whole fleet was in danger of getting stuck in the mud. So he turned back, little dreaming that four hundred years later his "River of Good Guidance" would be an object lesson for the world and worth far more to humanity than all the gold of the mythical Seven Cities.

A view of Black Canyon near the spot where Boulder Dam will block the flow of the Colorado. For countless years this great river has remained as we see it in the picture. Notice the sheer drop of the canyon walls, cut from solid rock by the river in its ceaseless march to the sea.

Later the river bore many names, one of them being the River of Good Hope. But at last Father Garces, one of the first missionaries to bring Christianity to the Southwest, named it El Rio Colorado, or the Red River, because of the reddish color of the water at certain seasons.

The Colorado River Drains an Area Larger than Germany

The Colorado River drains portions of seven states; Wyoming, Colorado, New Mexico, Utah, Arizona, Nevada and California. Its basin is bigger than Germany, which has a population of 65,000,000 people. It is bigger than France and Spain combined. It is almost as big as the combined areas of the states of Ohio, Indiana, Illinois, Michigan, and Wisconsin, which have a population of 25,000,000 people. Yet the population of that basin is but a few million people. The lack of sufficient water has held back settlement.

Boulder Dam will make it possible for several million more people to live on what might be called the California side of the dam, while developments on the other side, or above the dam, will open opportunities for many others. So this gigantic dam is likely to bring about one of the greatest and swiftest shifts of population in the history of the world.

Because the Colorado River ran through thinly populated country it was almost unknown so long as it behaved itself, or so long as few ranchers settled near enough to it to be seriously troubled by its bad behavior. But each year the waters of the river carry down more silt than the Americans excavated in building the Panama Canal. In time ranchers discovered that the silt, carried down the river and deposited on the floor of the

Courtesy of H. A. Erickson

Upstream night view in Black Canyon

valley through the centuries, had made the soil of the valleys, through which the river spreads on the last 200 miles of its 1700-mile journey, extremely fertile. The climate of that area has made it possible for farmers there to put fruits and vegetables on the market much earlier than could the farmers of other districts. The result was that in the first few years of this century the Imperial Valley became a busy and prosperous farming section. Today, the Imperial Valley furnishes a large share of the truck crops of the entire nation.

The Colorado River Is "The American Nile"

When one studies the Colorado River in that area one understands why the Nile River used to overflow its banks so regularly that the farmers of Bible times "cast their bread upon the waters," or threw seeds on the waters for the river to "plant" for them. When the Nile overflowed, the seeds were deposited over miles of land, in a layer of rich silt, and grew there when the flood was over.

Looking south from the site of Boulder Dam. Before work on the dam itself could be started it was necessary to construct roads into the floor of the canyon. Some idea of the difficulty of this work may be obtained from this photograph. Note the grapevine curves of the road on the right. The bridge, in the foreground, is the forerunner of the great roadway that will carry millions of persons over the crest of the dam.

Through centuries the silt, dropped in the bed of the Colorado River and spread along its sides, has actually raised the bottom of the river higher in places than the floor of the Imperial Valley, a part of which is below sea level. That is, the river flows through a ridge of silt which it has deposited there and is held in by banks of silt. Naturally, those banks are not strong. Through the mountains, where the river has patiently carved its course a thousand feet deep through walls of granite, the high water of the flood season could do little harm, but when it struck the soft walls which border the river through Imperial Valley there was always danger of destruction, if not death.

In 1906 flood waters broke through those banks and the valley was so terribly flooded that in all the years since then not all the flood water has evaporated or sunk into the soil. The Salton Sea, covering nearly four hundred square miles and ranking as one of the great lakes of America, was formed by the flood waters at that time.

The Great Flood of 1906 Aroused Country

That flood, destroying farms and homes and lives, aroused the whole country to the fact that the Colorado was a great force for ill which could be turned into a great force for good. The Imperial Valley ranchers were not content to cast their seed on the waters to grow wherever the flood might deposit it. They insisted that the river be controlled and become their best friend instead of their most deadly enemy.

The fact was brought out that the Colorado was the third largest river in the United States. President Theodore Roosevelt was interested, and in that same year he recommended to Congress the taking of steps to prevent future floods on the Colorado

River. In 1909 Congress enacted what is known as the Kincaid Act, authorizing a detailed survey of the lower Colorado River. The United States Reclamation Service next devoted two years to study of the flood problem, under the direction of Arthur Powell Davis, Director, and Frank E. Weymouth, Chief Engineer, of the United States Reclamation Service.

Before the dam could be started, it was necessary to divert the course of the Colorado River. The above picture shows how this skilful piece of engineering was accomplished. In the distance may be seen the river itself and in the foreground the end of one of the 4000 foot tunnels through which the river flowed while the dam was being constructed. Later these tunnels will be used to regulate the amount of water which will be allowed to pass down the river.

Their report to the Secretary of the Interior recommended that a canal system be constructed from the Colorado River to the Imperial Valley, and that a dam be built in Boulder Canyon which would stabilize the supply of water for irrigation. It is doubtful that anything would have been done about it for a long time had only a few thousand people in the Imperial Valley been affected. It was when citizens of Los Angeles and other southern California cities realized they might face a water shortage within twenty years unless some great new source of water were found, that the need for Boulder Dam became apparent. So it was not until 1922 that Congress authorized the creation of a Colorado River Commission, headed by Herbert Hoover, then Secretary of Commerce, and with one representative from each of the seven states. In October of that same year the commission met in Santa Fe, New Mexico, and drew up what is known as the Colorado River Compact. That compact provided, in effect, that the flow of the Colorado River should be divided equally between the states of the upper basin and those of the lower basin; Arizona, Nevada, and California being the lower basin states.

That did not entirely suit California, however, as a high dam was not planned, and California would lose Colorado River water rights already perfected unless a high dam were built to regulate the river and save for use the flood waters then going to waste.

United States Senator Hiram Johnson and Congressman Phil D. Swing introduced in the United States Senate and House of Representatives a bill "to provide for the protection and development of the lower Colorado basin," in December, 1922.

There was so much to adjust between the different states that it was not until May, 1928, that the House passed the Boulder Canyon Dam Bill, and not until December of that year that it was adopted by the Senate. President Coolidge signed the measure a few days later. Under that measure the government could spend $165,000,000 on the dam, the All-American Canal, and the power plant. The aqueduct which will supply the Metropolitan Water District, made up of Los Angeles and surrounding cities, will cost $220,000,000 more.

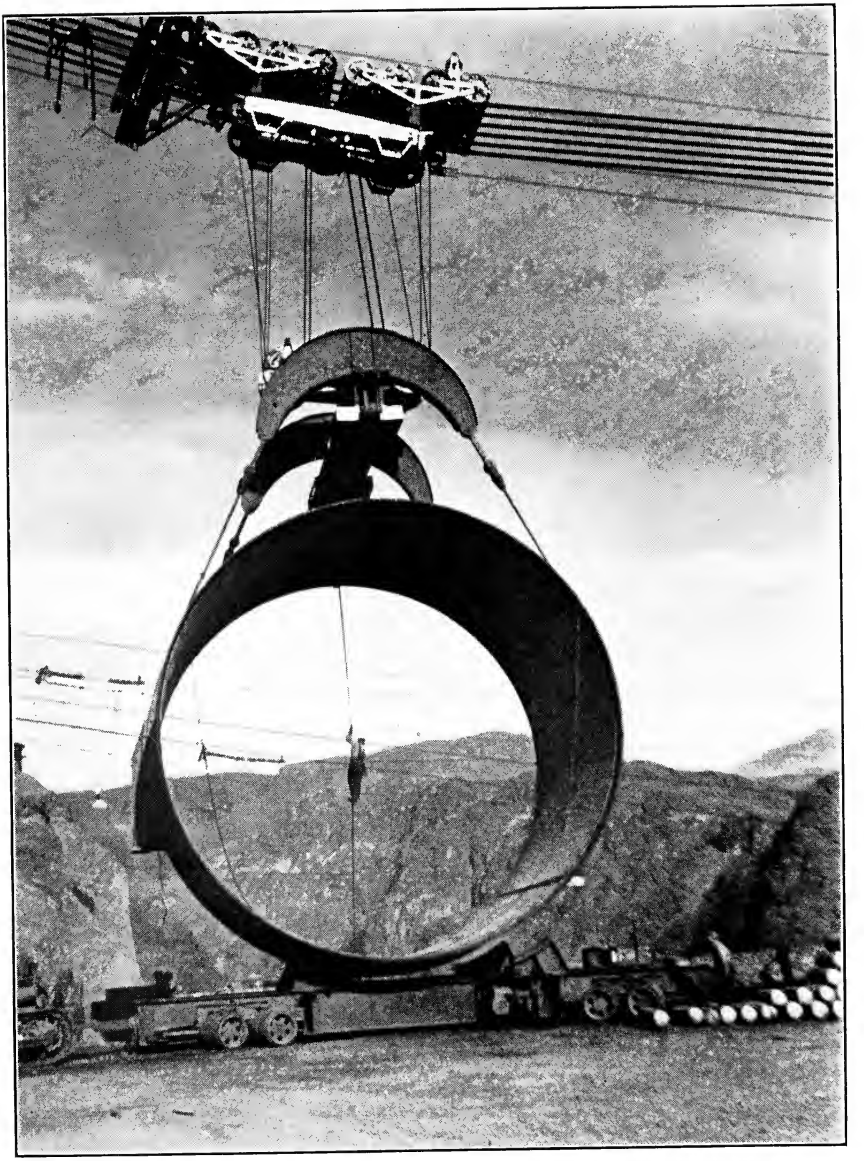
Boulder Dam and the Great Pyramid

We have seen that the Colorado River is like the Nile in that it carries much silt which, filling up the river bed, often causes overflows. We have seen, too, that Los Angeles and other southern California cities are situated somewhat as was ancient Babylon. So let us look back to Egypt and to Babylon again to realize how much the world has progressed, how much better able man is to care for himself now than he was then and how unlikely history is to repeat itself.

Work on Boulder Dam has progressed at five hundred times the rate of speed which was possible when the Great Pyramid was built. One hundred thousand Egyptians of that time might have been able to build Boulder Dam in twenty years, but they could not have built it so strongly for they did not know how. Three thousand five hundred men completed the main structure of the dam in less than two years and built it so strongly that it should outlast our civilization as the pyramids outlasted theirs.

Those men stretched across the canyon, from a thousand-foot rocky cliff on the Nevada side to a thousand-foot cliff on the Arizona side, a cable which would carry a load of 350,000

Boulder Dam in the last stages of construction. Notice the power plant rooted into the base of the dam. The block or sectional method of pouring the concrete for the dam itself is clearly indicated in this picture.



Transported by the government's 150 ton cableway, this section of steel pipe, 30 feet in diameter, is on its way to be installed in one of the four main conduits of Boulder Dam. The pipe will carry water from the intake gates on the upstream side of the dam to the penstocks which connect to the giant hydro-electric generators in the power plant. Sections of this type vary in wall thickness from 1 3-4 to 2 3-4 inches, and weigh 150 tons.

pounds. That cable carried huge masses of steel as easily as the cash carriers in department stores carry a dollar bill. Those men built mighty cranes which could lift burdens which a herd of elephants could not have budged. Buckets of concrete which weighed tons were swung to exactly the right place and dropped there by crane operators who could not see them but were guided wholly by signals. Depending from those cranes, steel bars so heavy that a hundred men could not have lifted one floated through the air as softly as clouds and as silently as shadows, coming to rest just where they were needed. Tasks impossible to the brute force of the Egyptians were made easy by the brain force of modern science.

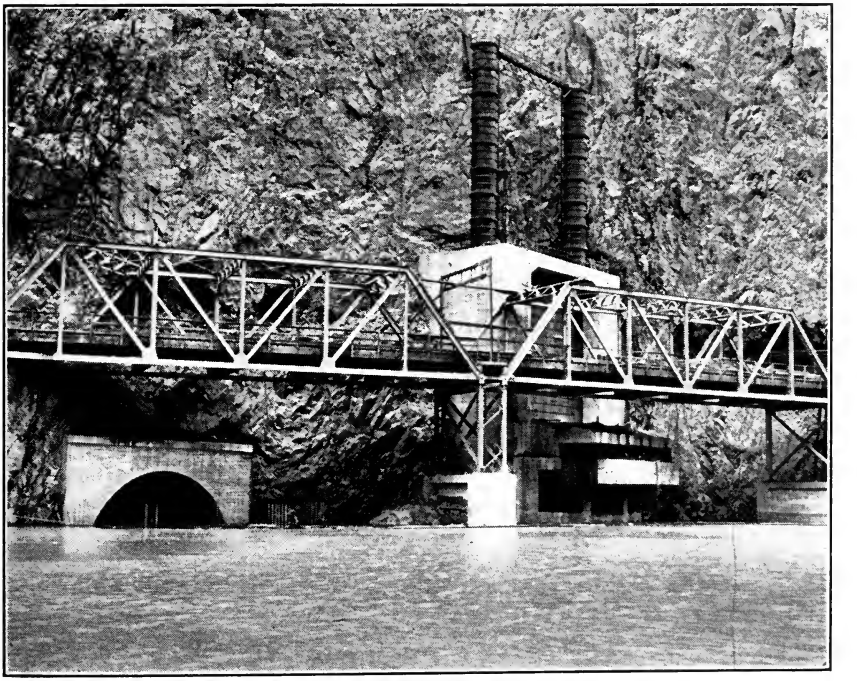
And while those men were building the dam, others were tunneling through the solid rock of the canyon sides. Four great tunnels, each big enough to carry the flow of a good sized river, were constructed. The tunnels are three-fourths of a mile long, beginning above the dam and ending near the power plant below the dam.

Flood and Drought Peril of Colorado Basin Forever Ended

Those tunnels and their mighty control gates, the engineers say, will forever put an end to both flood and drought in the areas below the dam. They will regulate the flow of the river, so that there will never be too much water in it, nor too little. When floods come they will be stopped by the highest dam in the world, backed up by the strongest dam in the world, and spread out over the largest artificial lake in the world. Only the normal river flow will be allowed to pass those great flood gates, to go murmuring instead of roaring across the rich and fertile valleys below. And in time of drought the

normal flow still can be released daily from the enormous reservoir.

Those four tunnels, through which the river will be detoured, are built so that the water races through them at terrific speed. When the first one was completed, enough water to half fill it was released into it by the control gate. Four young engineers, working near, decided to swim through the



Complete view of one of the four tunnel openings

heart of the mountain. The racing water not only carried them through the four thousand foot tunnel in record time but carried them twelve miles down stream. After that, swimmers were

forbidden to enter the tunnels, as the swiftness of the current makes swimming dangerous.

When the pressure of a lake as deep as Boulder Lake forces water through these tunnels, the power of the water will be all that is desired. In the power plant below the dam, that roaring torrent, which would ruin the valleys below if uncontrolled, under perfect control will generate more electric power than is at present being generated from water in Germany, France, or the British Isles. In this age, electric power is a sign of progress.

Boulder Dam is the Highest Dam Yet Built

We have said that this dam is the highest in the world. It is 726 feet high.

We have said that the lake formed by the dam will be the largest artificial or man-made lake ever built. It will be 115 miles long, with a shore line about as long as from San Diego to San Francisco.

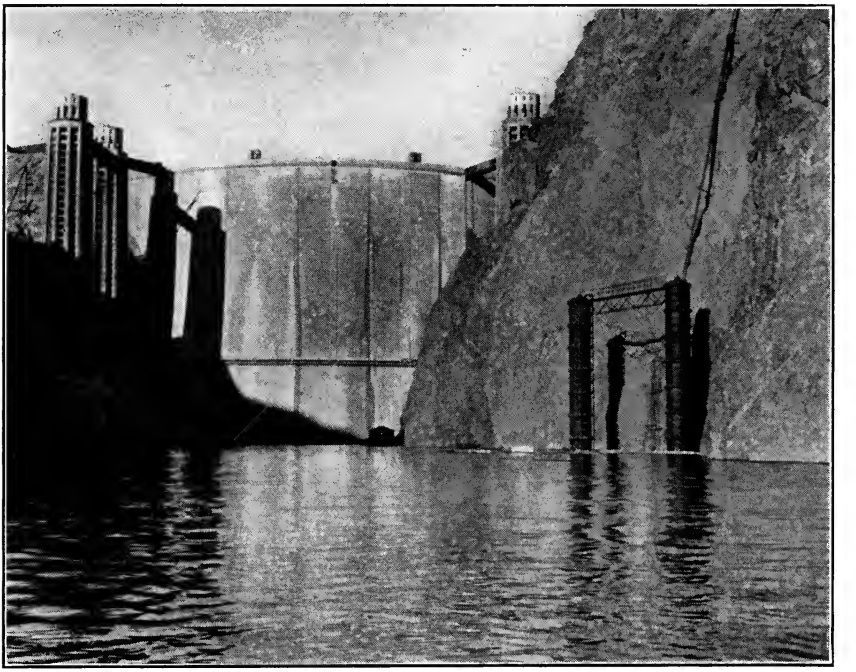
We have said that the Colorado River carries more silt than any other river except the Nile. Yet the engineers tell us that the lake will be so big that the amount of silt deposited in it will not become a problem for 150 years.

We have seen that Boulder Dam will end the dangers of flood in the Imperial Valley. Now let us see some of the ways in which it will benefit the Southwest as a whole and California in particular.

To some extent, that great lake in the Colorado Canyon will change the temperature by cooling the atmosphere. So will the changing of areas of desert lands into fertile irrigated lands.

Water is measured by acre-feet. One acre-foot of water will cover an acre of land one foot deep. In the past, and for

centuries, an average of 16,000,000 acre-feet of water run-off has washed down the Colorado River into the Gulf of California and been wasted, so far as use by the people of the Southwest



Upstream face of Boulder Dam with two intake towers visible on left. Two cylindrical structures in right foreground are operating equipment for raising and lowering the gate which covers the entrance of one of the four diversion tunnels. The gate is covered with water.

was concerned. Under the compact or agreement between the states, the upper basin states will have the right to use 7,500,000 acre-feet of that water, and the lower basin states the same amount, with the right to the lower states to increase their beneficial use of such water one million acre-feet a year.

As the United States government recognizes California's need of this water, and as it was California's efforts which brought about the entire project, California has been allotted one-half of the surplus water, after the allotments to the other states have been filled. There should be a surplus of at least 1,000,000 acre-feet of water in a year of normal rainfall, and in years when there have been heavy rains and snows in the Colorado basin the surplus will be much greater.

How California Will Divide Her Share of the Colorado River Water

Here is the division to be made of the water which California will receive. To the Palo Verde Irrigation Project, the federal irrigation project near Yuma, the lands in Imperial and Coachella valleys, and the lower Palo Verde Mesa—3,850,000 acre-feet; to the Metropolitan Water District, the next 550,000 acre-feet; to be divided between the Metropolitan Water District and San Diego, the next 662,000 acre-feet—San Diego to get 112,000 acre-feet of this amount; to Imperial and Coachella valleys and to 16,000 acres of the lower Palo Verde Mesa, the next 300,000 acre-feet; and the remainder for agricultural use in the Colorado River basin of California.

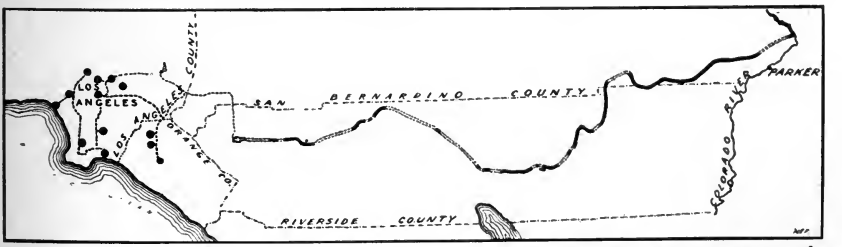
The Metropolitan Water District's share of this water will amount to about one billion gallons daily. The city of Los Angeles and the twelve other cities in Los Angeles and Orange counties, which have formed the Metropolitan Water District, already have water for all their present needs unless a long period of dry years occurs, and this new flow of "liquid silver" will be additional to what this district has from other sources. Thus the danger of water shortage in southern California will be ended, and vast amounts of additional water will be provided for irrigation.

Cities Cooperate to Build Great Colorado Aqueduct

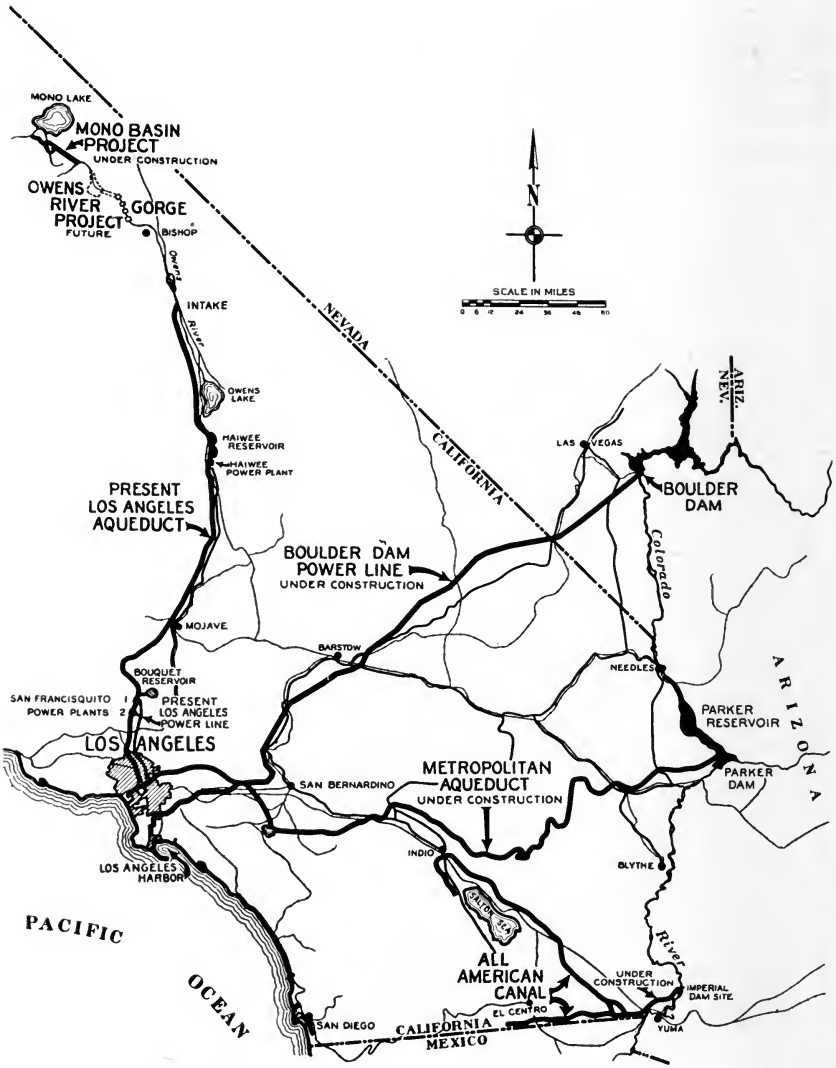
The aqueduct for the Metropolitan Water District and the All American Canal are themselves two of the greatest enterprises in modern history. They are linked with Boulder Dam and are dependent on it, but are really separate achievements.

Work on the aqueduct began in November, 1932, and it was expected that six years would be required to complete the giant task. Ten thousand men, on the average, will be employed in this work, and at times as many as 16,000 will be employed. The aqueduct will be 242 miles long, combining 66 miles of canals, 56 miles of conduits, 28 miles of pipeline and 92 miles of tunnels. That last item, 92 miles of tunnels, in itself tells a story of a tremendous task. The tunnels go through mountains and, in some places, under cities. Through the aqueduct one million acre-feet of water will be delivered each year to the cities interested in the great project.

Southern California long ago learned the value and necessity of cooperation. The first American pioneers there lived far apart and had to rely on one another for help in emergencies. They got into the neighborly habit of helping one another. As the population increased they learned that new problems arose



A man-made river. The Colorado River Aqueduct will carry water to the cities shown by the black dots on the map. The dotted portions of the aqueduct indicate tunnel construction.



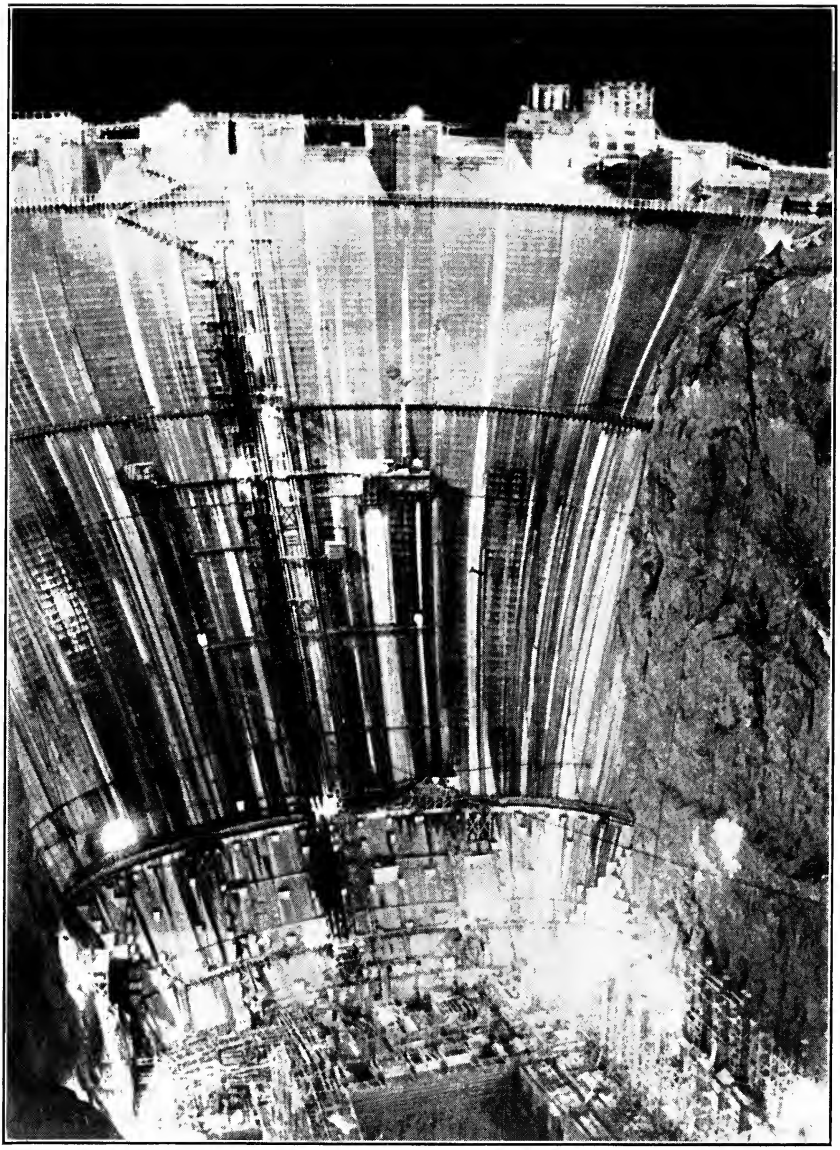
Map showing major southern California water projects

which small communities could not solve for themselves, but which several communities working together could solve. In this case the cities of Anaheim, Beverly Hills, Burbank, Compton, Fullerton, Glendale, Torrance, Long Beach, Pasadena, San Marino, Santa Ana, Santa Monica, and Los Angeles banded together to take the responsibility for an aqueduct which will cost $220,000,000.

The All American Canal and What its Name Implies

When Colorado River water first was used for irrigation in the Imperial Valley the Imperial Canal was built. But as the Colorado River makes a bend to the south and runs through Mexico in that neighborhood, most of the water used in the Imperial Valley comes through Mexico. It was not desirable for ranchers in the United States to be dependent on water transported through Mexico, so the All American Canal was planned to take water from the Colorado River at a point about 15 miles northeast of Yuma, Arizona, within the United States, and transport it by a route which is wholly within the United States. Of the $165,000,000 appropriated for Boulder Dam, $38,500,000 is for the purpose of building the All American Canal.

The All American Canal will create a man-made river larger than any other river in southern California. It will be 232 feet wide at its top and 160 feet wide at the bottom, and its length will be 80 miles to the Imperial Valley and 130 miles to the Coachella Valley. It will be more than twenty feet deep all the way. Only two canals comparable to it have been built in the United States and both are ship canals. It will carry nearly six times as much water as any other canal built by the United States Reclamation Service. Enough water



Courtesy of Standard Oil Company of California

A view of the completed dam and the partially completed power plant taken at night

will flow through it to meet the needs of the Yuma irrigation project, the Imperial Valley, the Coachella Valley, and San Diego. At Pilot Knob the water pressure will be great enough to generate 60,000 kilowatts of electricity.

Altogether, the All American Canal and its branches will irrigate about 1,000,000 acres of land.

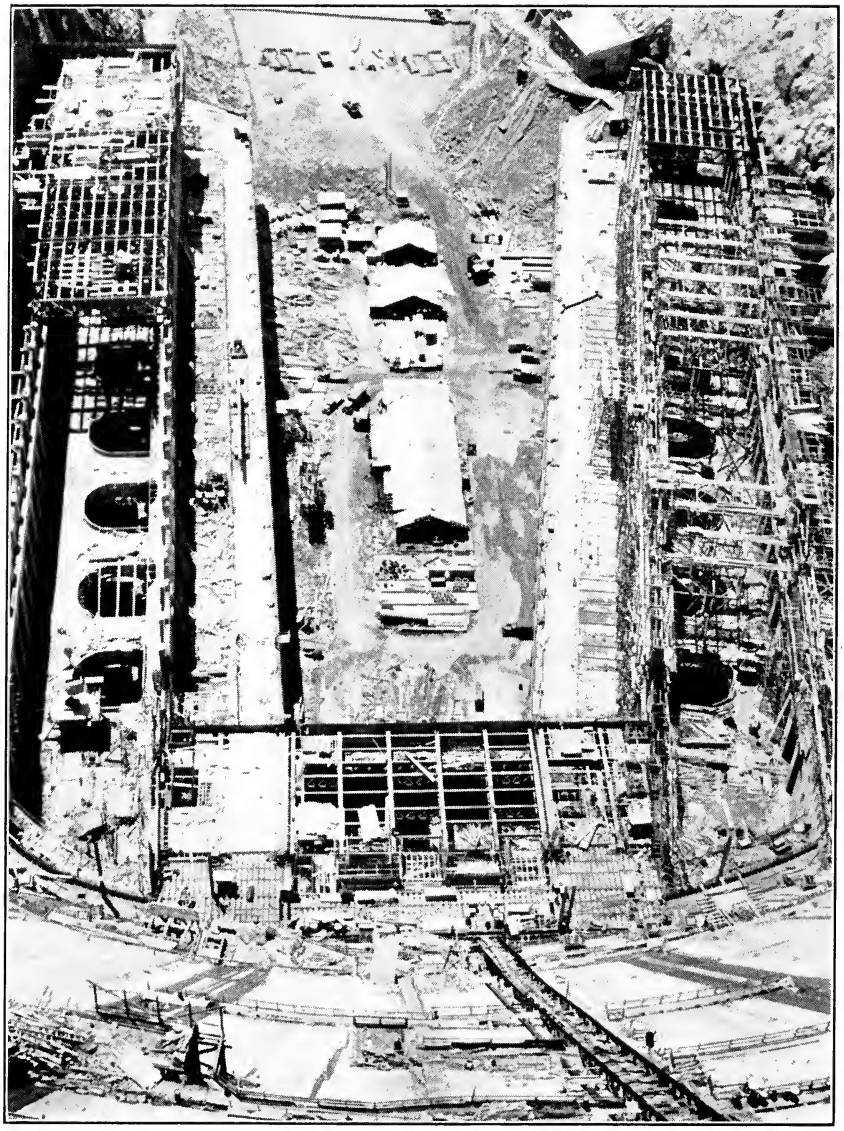
At the present time about 425,000 acres in the Imperial Valley and 16,000 acres in the Coachella Valley are irrigated. In each of those extremely fertile valleys, which supply America with winter lettuce, and in which melons and similar crops can be produced earlier than anywhere else in the United States, there are about 100,000 acres more of irrigable land.

The Boulder Dam Project Will Pay for Itself With Electricity

Though it was southern California's need of water which caused the building of Boulder Dam, it was the fact that it will generate more hydroelectric energy, or water power electricity, than previously could be generated anywhere else in the world, which made it possible.

The United States government could not have advanced the money for this great enterprise unless it appeared certain that the money could and would be repaid. To repay it by taxes would have placed too heavy a burden on the people. The sale of electricity provided the way to make the payments.

The city of Los Angeles already had proved what could be done through the sale of electrical power. In 1905 it had begun to build its first great aqueduct, extending 250 miles into the Owens River Valley. That aqueduct was completed in 1913. The great reservoir of the Owens Valley project is 4000 feet



Looking directly into the power plant from the top of Boulder Dam. The horseshoe openings are the pits in which the hydroelectric generators are to be installed.

higher than Los Angeles and wherever a great body of water has sufficient fall to make it run through a power plant with terrific force electricity can be generated. In 1917, Los Angeles began to sell power from Owens Valley to its citizens and its industries. It is an interesting fact that the first year the industrial products of Los Angeles reached a value of $167,000,000, while ten years later the total for the year reached $1,250,000,000. Figures submitted in 1928, when Boulder Dam was under consideration, convinced the Secretary of the Interior and members of Congress that the Owens Valley project had not only provided Los Angeles with water but, through the sale of electricity, was paying for itself and yielding a profit to the city. When the Boulder Dam appropriation was voted the Secretary of the Interior said it would not have been possible had not Los Angeles already proved what could be done.

All of Southern California is to Be Electrified

It is believed that the astonishing advance of Los Angeles following the building of that first great power plant will be mirrored by the great advance of all of southern California following the completion of the Boulder Canyon power plant. It will not only supply electricity to cities and towns but to ranches for pumping irrigation water, and many other uses. It will aid in making rural life as attractive and convenient as city life without taking from it any of the advantages of rural life. It will make electricity as much the friend and workman of the farmer as it previously has been of the city industrialist, and will make it cheaper as well.

The Boulder Canyon power plant has a capacity of 1,835,000 horsepower, compared to 452,000 horsepower generated at

Close-up of power plant with the finished dam structure in the background. The force generated by the fall of water from Boulder Lake, behind Boulder Dam, will be turned into electric power which will move great machines, provide power for transportation, and produce light and heat for millions of persons in the Pacific Southwest. The power plant is as high as a 19 story building.

Niagara Falls and 250,000 horsepower at Muscle Shoals, although the latter plant has an ultimate capacity of 600,000 horsepower. In the Boulder Canyon plant will be two turbines with capacity of 55,000 horsepower each and fifteen with capacity of 115,000 horsepower each.

The Boulder Canyon power plant does not look very big beside the great dam, but it is as tall as a nineteen-story building. Stretching 270 miles from that power plant to Los Angeles, over

Neither desert nor mountain stops the onward march of progress. In this view we see an age-old Joshua tree and near by one of the newest types of the steel towers, which have been built between Boulder Dam and the Los Angeles area, to support the 275,000 volt power lines which will bring electricity from the power house at the foot of the dam.

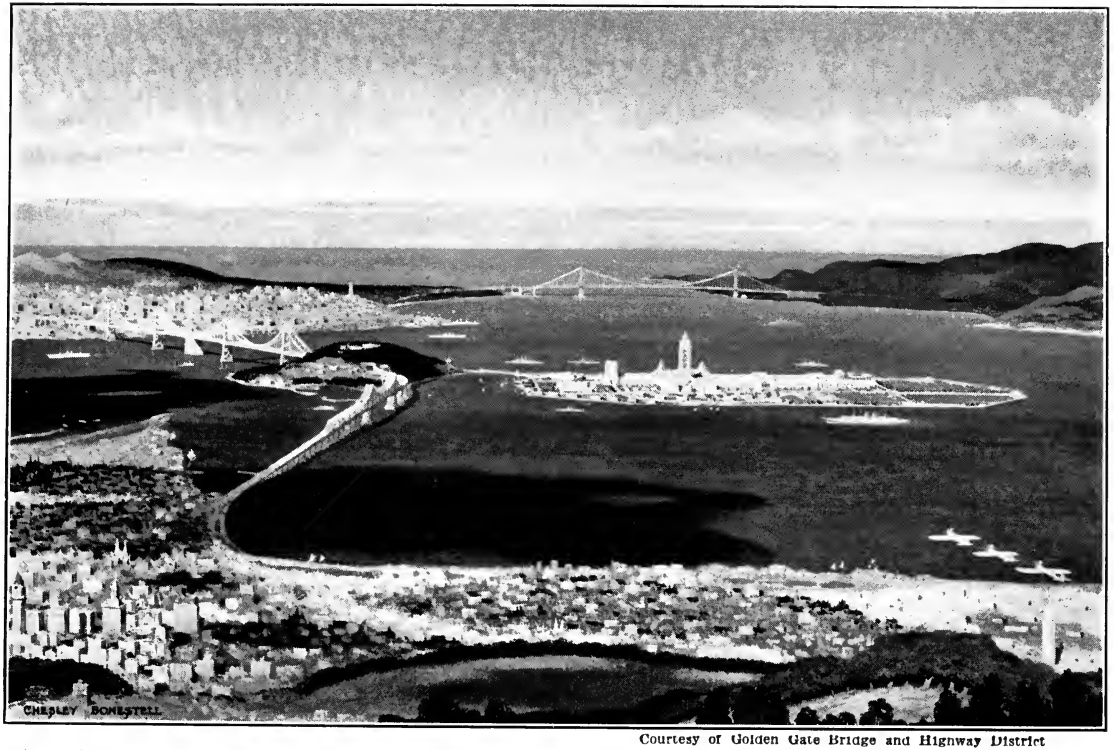
desert and mountains, is rising the greatest power transmission line ever built, a 275,000 volt two-circuit line. The Reconstruction Finance Corporation lent the Los Angeles Department of Water and Power $22,500,000 for the building of that power line alone. It is planned that the Department of Water and Power will generate about 91 per cent of the power for use by cities, the Metropolitan Water District, and other states desiring power from Boulder Dam. The remaining 9 per cent of the power is to be generated by the Southern California Edison Company.

It will be seen, therefore, that Boulder Dam will spread its benefits through the Southwest from the Rocky Mountains to the Pacific Coast, and will make room and opportunity for millions of additional people to live in California. And the 4,330,000,000 kilowatt hours of electricity which is to be generated by the power plant at the foot of the dam will place electricity for all purposes of living and of business within reach of both the ranchers close to the river and the city dwellers hundreds of miles away.

Boulder Dam is the World's Greatest Monument to the Spirit of Today

Through the vision, energy, and courage of men, the Southwest's river of destruction has been changed into a river of destiny. Its once terrible floods, under proper control, have become the greatest blessing a thirsty land has ever known. The highest dam in the world, which those men have built, well might be called the loftiest monument to the spirit of today, the spirit which does not meekly submit to forces which threaten to destroy it but harnesses those forces and makes them friends of man.

HOW THE SAN FRANCISCO BAY AREA IS BRIDGING DIFFICULTIES



Courtesy of Golden Gate Bridge and Highway District

Aerial view of San Francisco Bay with artist's drawing of the Golden Gate Bridge, the San Francisco-Oakland Bay Bridge, and the site of the Golden Gate International Exposition

The Golden Gate and San Francisco-Oakland Bay Bridges

How the San Francisco Bay Area Is Bridging Its Difficulties

The timid man who said he would not cross the ocean until they built a bridge at last is to have his chance. Two bridges greater than ever before have been built by man, or even dreamed of by the people of any other land, are rising out of the sea. One is across the Golden Gate, from San Francisco to Marin County. The other is across San Francisco Bay, from San Francisco to Oakland. They are not bridges "across the ocean," of course, but they span, or reach across, more of the ocean than any bridge ever crossed before.

Such modern miracles are those bridges that engineers all over the world are reading about them with wonder like that of children when they read fairy stories. Before they were half completed thousands of tourists were coming to California just to see the bridges which are, in many respects, the most remarkable structures ever built by men.

Those who built the great pyramids of Egypt would have shaken their heads and said that anyone who believed such bridges could be built was insane. Even such mighty structures as Boulder Dam presented no such engineering problems as did these bridges.

Most Heroic Expression of California Spirit

Therefore the bridges might be called the most heroic expression of the California spirit. They had to be built. They were necessary for the "unbottling" of San Francisco, and for the growth and progress of California. California has formed the

habit of doing "impossible" things when they are necessary. Indeed, most of the progress and success of mankind comes from forming that habit. Were it not for men who have achieved the "impossible" we would not now have any motor cars or airplanes. Every young Californian has the right to treasure in his heart the fact that, since the days of the pioneers, Californians have been overcoming obstacles which seemed impossible. California has been arousing the wonder of the world ever since there was a California. Yet never before has even the California spirit flowered into such miracles as these bridges.

General Fremont Gave Golden Gate Its Name

The Golden Gate is the narrow passageway between the Pacific Ocean and an inland sea composed of San Francisco, San Pablo, and Suisun bays. That inland sea has a shore line so long that a resident of Marin County might be within a mile of San Francisco city yet, to reach it by land, he would have to travel several hundred miles. First he would have to travel north, then east, then south, then west, and then north again, up the peninsula. If you will form a reversed letter C with your right thumb and forefinger, the nail on the forefinger will be in a position similar to the position Marin County holds on the map of the San Francisco Bay area, while the thumb nail will represent the position of San Francisco. The small space between the two nails will represent the Golden Gate. This simple illustration will give you a good idea of the distance saved by placing a bridge across the Golden Gate.

As far back as the days of the early Spanish settlers people used to sigh and say it would be very helpful if there were a bridge across what now is known as the Golden Gate. They did

not believe there ever would or could be one. They either traveled around by land, taking many days for the journey, or traveled by boat. When General John C. Fremont, who gave the Golden Gate its name, built a home on the Marin County side he, too, often wished for a bridge.

Now, though lives are longer and all means of transportation are much more rapid than in those days, we no longer have the time to travel so slowly. Now we must do in a few minutes many things which then took days in order to keep up with modern progress. Portola, the first traveler in the Bay region, moved at the rate of ten miles a day. The other day an airplane flew from Los Angeles to San Francisco and back again at the rate of nearly 300 miles an hour. At that rate of speed it could have flown around the earth in 80 hours instead of in the 80 days which was considered impossible time when Jules Verne wrote *Around the World in Eighty Days*. The airplane could circle the entire globe in less time than Portola's army could have marched one-fourth of the distance from the Marin County shore of the Golden Gate to the San Francisco shore.

Ferry Boats Not Rapid Enough

The people of Marin, Sonoma, Mendocino, Napa, and Del Norte counties wanted to be closer to San Francisco, and San Franciscans wanted to be closer to them. The best and greatest system of ferry boats in the world operates in San Francisco Bay. They make such excellent speed that the bridges will save the people who use them an average of only 11 minutes a trip, or 22 minutes a day for most of them. Where hundreds of thousands of people are affected, however, the total of lost time becomes enormous. Twenty-two minutes a day for a million people

would equal nearly 46,000 eight-hour work days for one person or nearly 46 work days for one thousand men. Millions of people will use those bridges. Thus the time saved by these two great bridges in the course of a year would be enough for the building of a city. This gives us an idea of the value of the time many of us waste. If it is worth $112,000,000 to the Bay area to save its residents 22 minutes a day, how much is your time worth to you?

Though people long have dreamed of a bridge across the Golden Gate, until recently the dream was considered as impossible as a dream of a bridge to Hawaii would be considered now. Even the stout explorer, Fremont, who had overcome obstacles other men believed could not be overcome, never seriously imagined that the bridge he wished were across the Golden Gate could ever be there. In his time it was impossible, and for many years afterward it was impossible.

Leland Stanford First Proposed Building Bridges

Yet, as early as 1867, Leland Stanford, considering routes for his Central Pacific Railroad, declared that a bridge across San Francisco Bay from Oakland to San Francisco could and should be built. Very few people believed him. Most people smiled as most people do now when someone says he can build a skyrocket which will carry him to the moon. However, Stanford succeeded so well in other things that his opinion on anything was treated with respect. As years went by and the population grew and the bridges were needed more and more, they became a certainty. The history of America, and especially the history of California, shows that someone always finds a way to do anything which has become necessary to a great number of people.

San Francisco Was First Great City of the West

The bridges had become necessary because San Francisco was "bottled." In 1849 San Francisco became the big city of the West, the gateway to commerce, and the city which every visitor wished to see. Such travelers as Robert Louis Stevenson felt that they might miss much of America but they must know San Francisco. It became the trade capital of not only California but the entire West. Men from San Francisco developed the almost fabulous mines of Nevada, and their homes and headquarters remained in San Francisco. It was to reach San Francisco that the railroads were built across the Great Divide. It was from this western metropolis that ships put out to sail the seven seas and San Francisco became the first center of art and culture in what then was known as the "wild and woolly" West.

San Francisco always was a city of dash and daring, of courage and of conquest, demanding the best as its birthright. It is related that in the days of the gold rush, miners contributed $10,000 in gold dust to bring the first grand opera troupe to San Francisco, just because they had heard that the cultured people of "other great cities"—such as London, Paris, and Berlin—liked grand opera. The first State University had to be near San Francisco, the first railroad and steamship lines had to have headquarters there.

So San Francisco grew like an avocado seed in a bottle. Many of you have started avocado seeds growing in milk bottles. You know that if you fill the bottle with water and then place the seed in it as a sort of stopper, it will grow very rapidly. But soon it has to have more room. When San Francisco grew large

enough to fill the "thumbnail" of the peninsula, its growth became slower and more difficult. It was bottled. It was great in spite of its handicaps, but its handicaps kept it from being as great as it should be. To hold its rightful place among the great seaports of the world, it must overcome its natural handicaps and make greater use than ever of its natural advantages. To call attention to its leadership it must work miracles which would make the whole world gaze in wonder.

And that is just what San Francisco did, with the hearty aid of all its neighbors.

Army and Navy Opposed Bridges at First. Even when San Francisco and its mainland neighbors realized what they must do they met many heart-breaking discouragements. For a long time the United States Army and Navy stood in the way, seeing in the proposed bridges a menace to the safety of San Francisco and all the ships in the Bay.

During the war with Spain, Captain Richmond P. Hobson tried to block the Spanish fleet in Santiago Bay by sinking a single small ship in the mouth of the harbor. In the World War, German submarines were blocked in the harbors of Ostend and Zeebrugge by the sinking of rather small ships. Think what would happen if, in time of war, the greatest bridges in the world could be hurled down to block San Francisco Bay.

Finally, in 1919, the supervisors of San Francisco County ordered a geological survey to see if a bridge across the Golden Gate was possible. Then it was discovered that 1200 feet off shore, or out in the open sea, from the south side of the Gate, there were solid rock foundations for a bridge greater than man had ever dreamed of before.

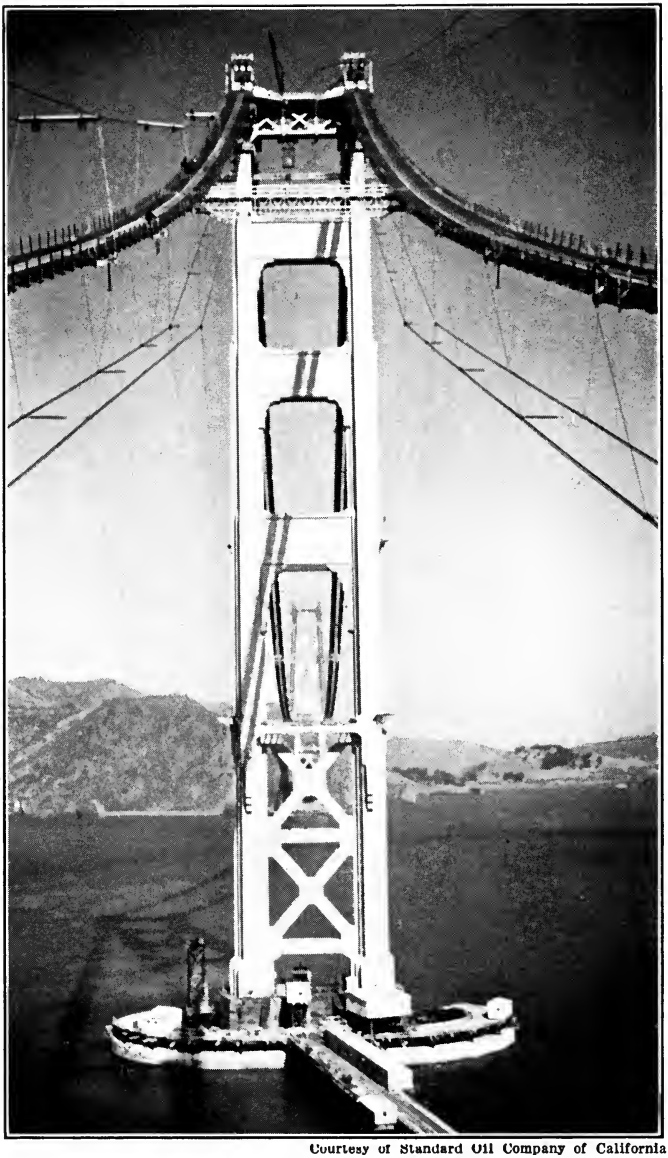
Still, many people shook their heads and thought the geologists and engineers were foolish. Never before had anyone planned to build piers on rock 100 feet below the surface, in the open sea, in front of an inlet, where mighty sucking tides forever raced in and out. Never before had anyone dreamed of a suspension bridge with a single span 4200 feet long. The famous Brooklyn bridge was a span only 1600 feet long.

It was not until 1924 that the War Department gave its consent to the building of the great bridge and not until 1930 that the Golden Gate Bridge and Highway District was formed. Some people even had gone to law to prevent the building of the bridge, believing it could not be done, and there had been five years of battles in the courts before the way was clear.

Golden Gate Bridge is Not a State Project

The Golden Gate Bridge and Highway District is composed of San Francisco, Marin, Sonoma, Mendocino, Napa, and Del Norte counties, and the Golden Gate Bridge is not a state project. Those counties have voted $35,000,000 in bonds, San Francisco guaranteeing 85 per cent of the money. The bridge will be a toll bridge until it is paid for, and it is expected that it will completely pay for itself in 35 years.

That bridge will not only bring all the northern counties into much more direct contact with San Francisco, but, with the Oakland bridge, will, in effect, put San Francisco and Oakland on the Redwood Highway and will link the Redwood and Coast Highways. Thus the bridges will give the state highway system a link it long has needed, and the California Department of Public Works is assisting this private enterprise of the northern counties all it can.



Courtesy of Standard Oil Company of California

A view of the Golden Gate Bridge taken from the south pylon showing both footbridges to the top of the San Francisco tower. Toward the top of the tower may be seen one of the cross bridges used in the spinning of the cable.

Had to Solve Problems Never Solved Before

The men who planned the Golden Gate Bridge could no more follow in the footsteps of other men than Columbus did when he sailed to discover America. All the progress of the world has been started by pioneers, whether they traveled over land or sea or through the byways of scientific discoveries. The engineers had to do things which never had been done before and which most people thought could not be done.

The famous Golden Gate is about one mile wide and three miles long. The water there is almost deep enough to cover the tallest building in California. No light from the sun can reach even 100 feet below the surface of the ocean, and the problem of building the foundations for mighty piers in the utter darkness 200 feet or more below the surface seemed too great to solve.

At last the geologists found that by going 1200 feet out to sea on the south side they could strike bedrock at about 100 feet.

Then another problem arose. The land, on both sides of the channel, on which it was possible to erect towers for a suspension bridge 700 feet longer than anyone had ever planned before, belonged to the War Department. Until the engineers could prove to the War Department that the bridge would be a help instead of a danger in time of war, it was not possible to proceed.

Suspension and Cantilever Bridges

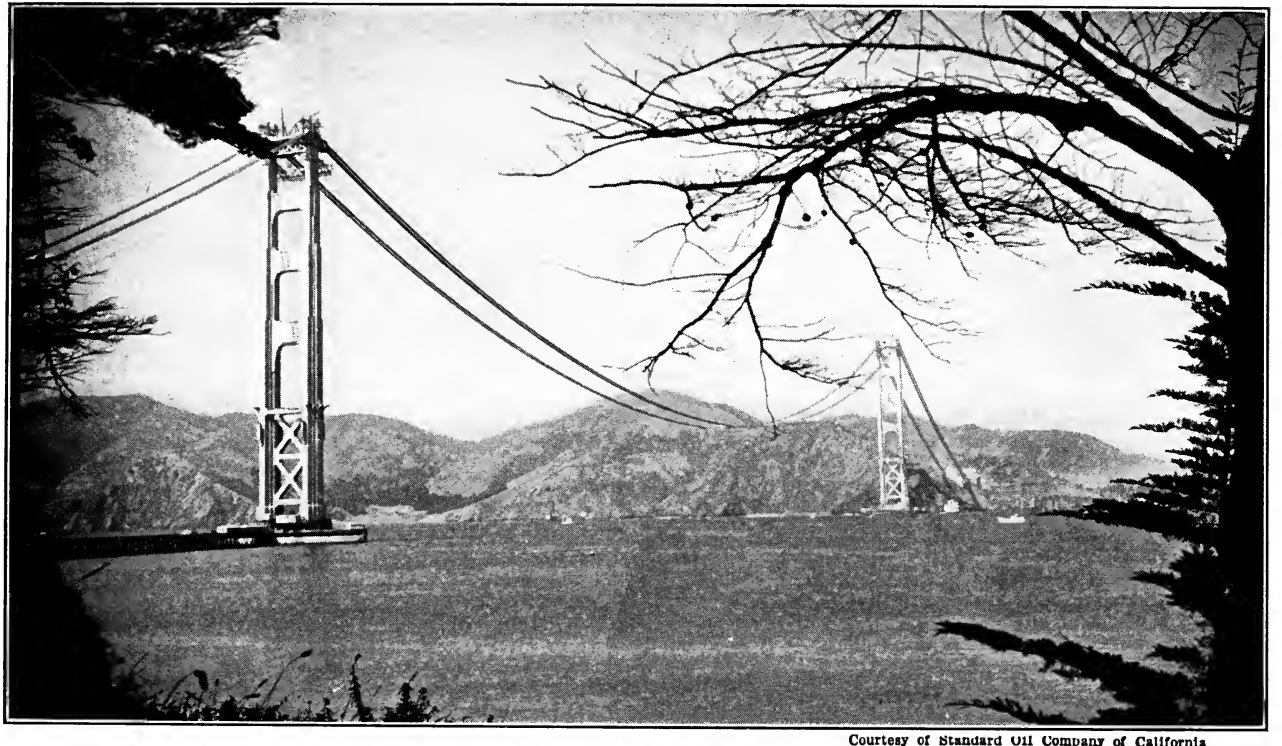
A suspension bridge is one which is suspended, or hung, on cables attached to towers on either end. Many people believed it would be impossible to build towers strong enough to support a suspension span nearly a mile long and so solid that street cars and hundreds of

Courtesy of Golden Gate Bridge and Highway District

Artist's conception of the Golden Gate Bridge, with San Francisco in the background

Courtesy of Standard Oil Company of California

Looking toward the Marin tower of the Golden Gate Bridge showing completed cable strands. Each strand is composed of approximately 250 to 550 wires each, which will eventually become a part of the 36½ inch cable.



Courtesy of Standard Oil Company of California

View of the Golden Gate Bridge during construction, taken from the San Francisco Presidio looking toward the Marin County hills. Both completed towers, 746 feet in height, with the footbridges extending across the 4,200 foot suspension may be seen.

motor cars could cross it at one time, adding to its own great weight. Each tower of that bridge has to be strong enough to stand a pull of 63,000,000 pounds from the cables.

The tower on the Marin County side rises 746 feet above the water, as does the tower on the San Francisco side. But the San Francisco tower rises 846 feet from bedrock, as 100 feet of it is under water. That makes it one of the tallest structures in the world, a little taller than the Woolworth Building in New York and almost as tall as the famous Eiffel Tower in Paris.

From those two towers the cables which support the main part of the bridge are suspended, hanging like a rainbow upside down. So big is the bridge that there are six lanes for motor vehicles on it and a sidewalk on each side of those lanes. Yet so graceful and beautiful are its proportions that, against the background of the great ocean, it looks like a spider web.

The bottom of the bridge is 220 feet above high tide, so that there will never be any ships so tall that they cannot pass under it easily. The towers for this bridge are 150 feet taller than those of the George Washington Bridge across the Hudson River, the second largest suspension bridge in the world.

The entire length of the bridge is 8940 feet.

First Great Tower Built in Open Sea

The greatest problem in building this bridge was caused by the necessity of building the tower on the San Francisco side 1200 feet off shore. Never before had man tried to build even a pier in the open sea where the water was more than 100 feet deep, much less one of the great towers of the world. More than an acre of the ocean floor had to be leveled to make a place for the foundations of

the giant tower. Deep sea divers had to go down into the ocean, where there was no light, and direct the people working above by telephone. Thousands of tons of rock had to be removed to make a place for the foundations, and that rock was carried out to sea and built into a breakwater. For the breakers at that point were often 20 feet high and it was impossible to work effectively in such water.

Other great problems the engineers had to solve before a start was made were the effects of wind and water and of heat and cold on so huge a structure. It also had to be built so that no earthquake could do it serious damage. Heat and cold will make this great bridge expand or contract, rise or lower, as much as 10 feet, but it will do no harm. A fierce wind, blowing through the channel, might make the towers sway as much as 20 feet, but the bridge will be more than twice as safe as it needs to be to stand unhurt in a wind blowing 90 miles an hour, while the strongest wind ever recorded there blew less than 60 miles an hour.

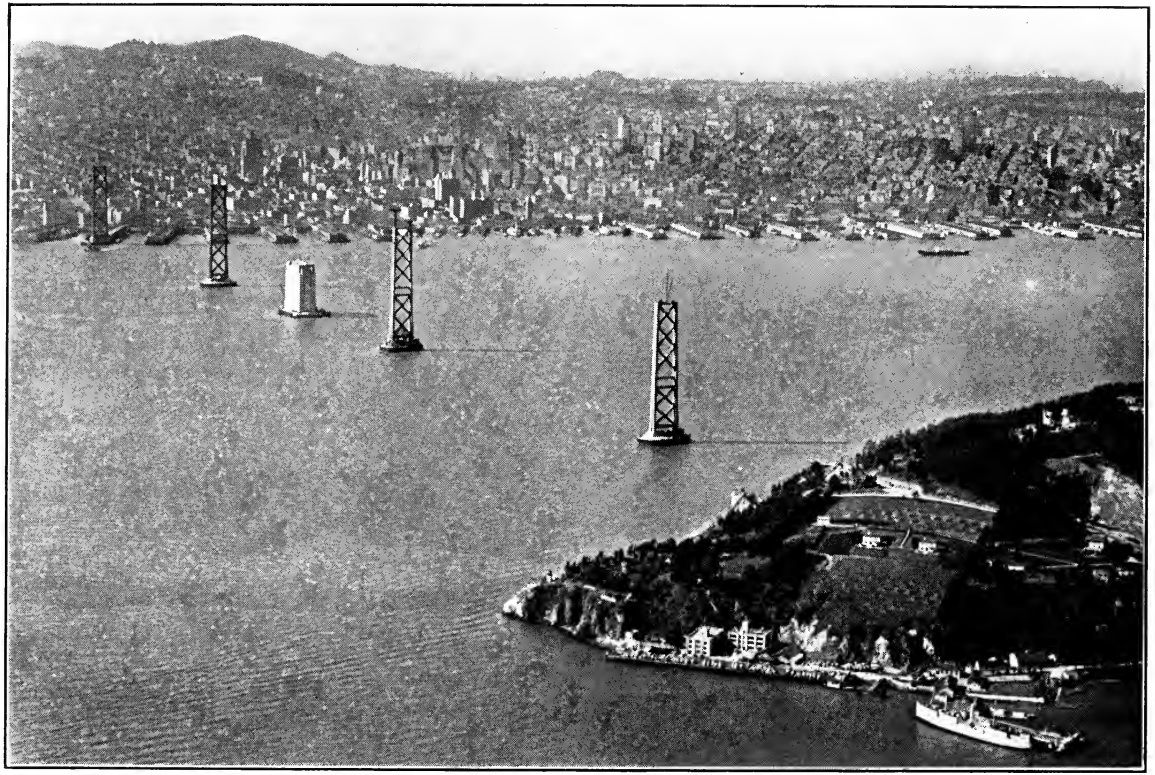
Golden Gate Bridge Costs $35,000,000 When ways to bridge all the other difficulties had been found, there still remained the problem of cost. Chief Engineer Joseph B. Strauss estimated that this new wonder of the world and its approaches could be built for $35,000,000. So many things had to be done for which there was no precedent or example to go by, that some high authorities feared the bridge would cost many times that amount. That was why lawsuits were filed to prevent the building of the bridge. However, when construction contracts were let it appeared that the figures of Engineer Strauss left a safe margin of more than $1,000,000.

Oakland Bridge by Far the Longest in the World

Great as were the problems of building the Golden Gate Bridge, the San Francisco-Oakland Bay Bridge presented some which, for a time, seemed to end all hope for that structure. Though it had been dreamed of ever since Leland Stanford first urged its building in 1867, no actual plans for building it had been drawn. For one thing, the rivers have been bringing down silt for centuries and there is a cushion of mud one hundred feet thick on the floor of San Francisco Bay. In spite of that, the water is very deep, and instead of bridging an inlet one mile wide there was the problem of bridging a bay several times that wide. The famous Brooklyn Bridge, once the largest in the world, would not reach one-fifth the distance across San Francisco Bay.

Where there is a will there is a way, however, and in 1929 San Francisco and Oakland raised money for a survey by geologists, as the counties most interested in the Golden Gate Bridge had done in 1919. The survey made by the Hoover-Young Commission discovered that between Yerba Buena Island and San Francisco there was a ridge of bedrock. Along that ridge the water was not so deep as it was on both sides of it. Even there, the floor of the bay is from 50 to 105 feet below the surface of the water, which gives an idea of how deep the bay is.

Yerba Buena Island is a military reservation, but by that time the War Department had seen the value of these great bridges, and not only gave consent to the building of the bridge but for the boring of the largest bore tunnel in the world through the high part of the island. Yerba Buena Island is generally known as Goat Island because an early resident kept a herd of goats there to supply meat to sailing vessels.



Bridge supports between San Francisco and Yerba Buena Island

To build the bridge by way of Yerba Buena, it must of necessity be more than 8 miles long. To build it big enough to carry the heavy traffic between Oakland and San Francisco meant it would cost more than twice as much as the Golden Gate Bridge.

It seems, however, that when people keep on trying and never give up something always happens to help them. The depression which was so hard on so many people was the thing which made this great bridge possible. Eager to encourage public works which would employ a great many people and help business, the United States government agreed to advance the money. On July 9, 1933, the work was started. The bridge will be open for traffic in November, 1936.

Modern Science and Engineering Make Impossible Things Possible

There are many details of the building of these bridges which only engineers can understand. Yet it is inspiring to tell some of the things done, simply as examples of what great things men can do when they make good use of their brains and their wills. Every man facing problems men never have faced before is an explorer and an adventurer, but he must succeed to be a discoverer.

How can you build piers, tied solidly into bedrock, in a place where there is a cushion of mud one hundred feet thick on top of the bedrock, and that cushion is one hundred feet below the surface, a depth to which no light can reach?

Well, if you would take a cylinder and cram it full of pencils you would see that the round pencils could not fit together closely, and there would be a good deal of space between them.

Courtesy of California Toll Bridge Authority

Two miles of suspension bridge catwalk over the west half of the San Francisco-Oakland Bay Bridge, as it appears from Yerba Buena Island

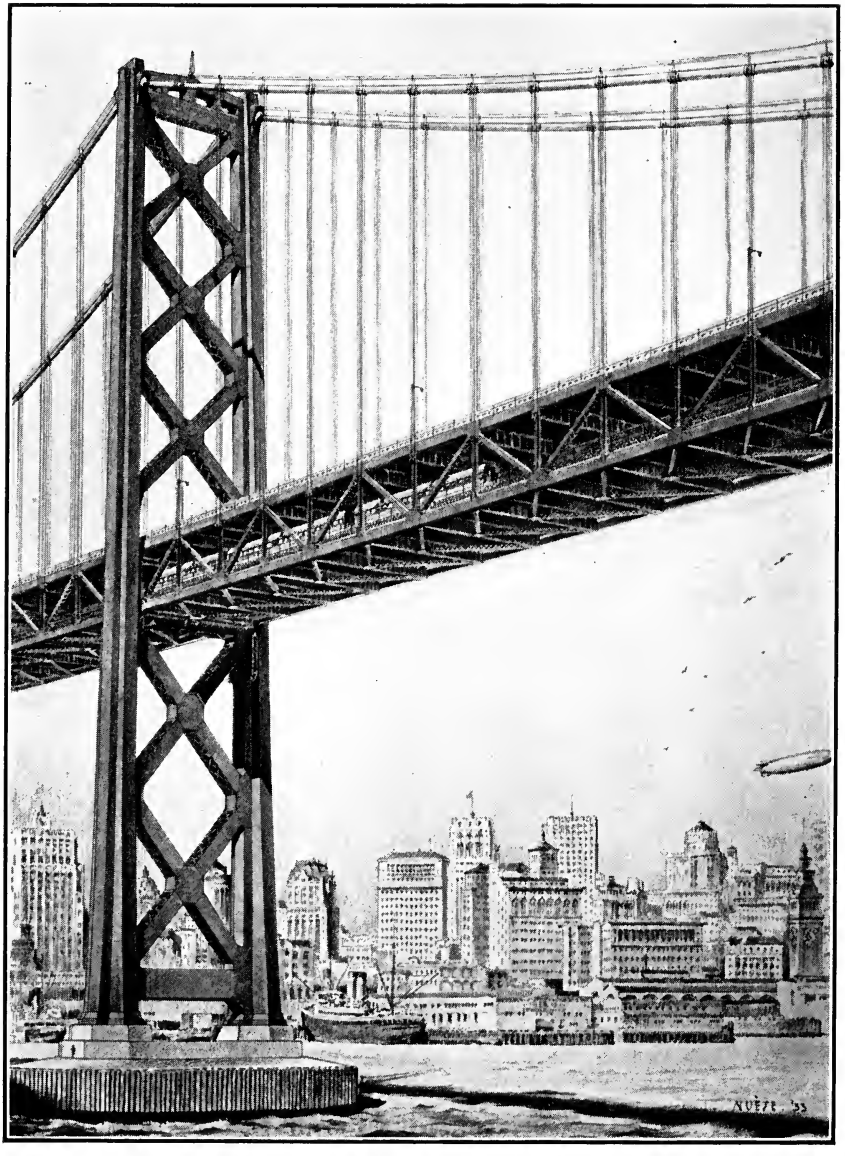
Instead of pencils, the pier builders took large steel tubes, so big that they could drop what they call clamshell buckets through them. A clamshell bucket is a sort of scoop which closes up like a clamshell on the earth it scoops out. A cluster of those steel tubes was placed in a huge cylinder. Then, when that huge cylinder was placed where it was wanted, concrete was poured in the spaces between the tubes and the whole mass was allowed to sink until it reached the mud. On the bottom of that sinking mass were cutting edges which, aided by the weight of steel and concrete, made it sink into the mud. The clamshell buckets, plunged through the steel tubes, brought up all the mud and rock the cutting edges displaced. Thus in time the mass of steel and concrete rested on bedrock—indeed, was sunk into bedrock. It was a comparatively simple matter to build up mighty piers from such a start.

Then there was the great problem of bridging a wider gap than either a cantilever bridge or a suspension bridge could span with safety.

Difference Between Suspension and Cantilever Types of Bridges

We have already told you what a suspension bridge is. As you will often hear people talk of cantilever bridges you should know what they are, too.

A cantilever bridge is not suspended from towers but is braced like brackets. If you have brackets holding up book shelves in your home you know how the brackets are braced by the walls from which they extend. If you put long brackets on opposite sides of a room and then connect the two ends you have a sort of cantilever bridge. That is a very rough idea, of course. A suspension bridge hangs like a clothesline, held up at each end

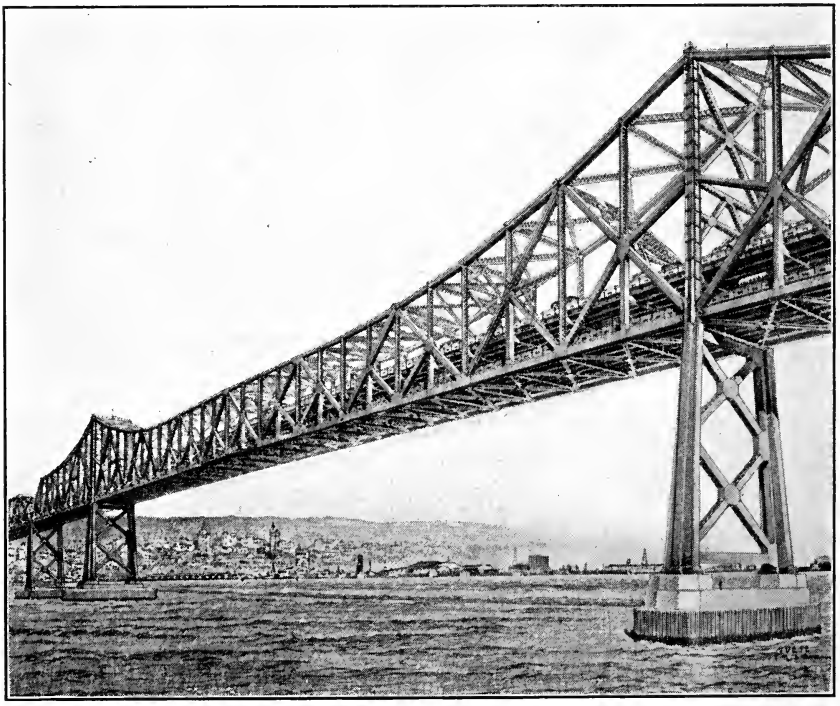


Artist's conception of a tower of the suspension bridge sector as it will appear when completed, with the sky line of San Francisco in background

by towers; a cantilever bridge is propped up like a balcony. As long as you can build piers to prop up a cantilever bridge it is strong, but where there is a very wide span in which piers cannot be built a suspension bridge is more practical.

But even the suspension bridge across the Golden Gate was not half so long as the bridge from Yerba Buena Island to San Francisco had to be. So Chief Engineer C. H. Purcell decided to do another thing never done before. He decided to build two suspension bridges in tandem across that part of the bay. Those of you who ride bicycles know that a tandem is a bicycle for two riders, one in front of the other. Those who drive horses know that a tandem team is one in which one horse is placed in front of the other in the same way. As the geologists found safe anchorage for giant towers near the middle of the space which had to be crossed, it was decided to build towers at that point. From those towers they would suspend, or hang, one bridge from that point to San Francisco and one to Yerba Buena, uniting them so that the great weight of one would pull against the great weight of the other. Thus each would brace and strengthen the other. If you would tie a rope around a tree and pull to one side with great force you might bend or break the tree. If another rope, with an equal force at its end, were pulling in the other direction, the tree would not bend in either direction. The pull on one side would brace it against the pull on the other. That is the idea on which these tandem suspension bridges are built, so that the weight of 38,000,000 pounds on one side is offset by the pull of 38,000,000 pounds on the other side. The center anchorage, rising 508 feet from bedrock, contains twice the cubic content of the Russ Building in San Francisco, which is 31 stories tall.

Between Yerba Buena Island and the city of Oakland the bridge is a cantilever and truss structure more than two miles long, but supported by many great piers. Most of the great bridges built before have no more than five or six piers, but this bridge will rest on 51 piers between San Francisco and Oakland.



Artist's conception of the 1400 foot cantilever span of the East Bay crossing as it will appear when completed, with the city of Oakland in the background

A Bridge Which Passes Through a Tunnel

On Yerba Buena Island the bridge passes through the largest bore tunnel in the world, 76 feet wide and 58 feet high. It is the only tunnel high enough and wide enough for a double-decked, or

two-story, bridge to pass through. The lower deck is big enough for two street car tracks and three lanes for motor truck traffic, and the upper deck is big enough for six lanes of automobiles.

So much earth had to be excavated, or taken out, in boring this tunnel that it will provide 160 acres of land for a new man-made island lying to the north of Yerba Buena Island. During 1936 this island will be enlarged to 430 acres by means of dredging. The island will be the site of the Golden Gate International Exposition which will open February 18, 1939. After the exposition the site will be used for a modern municipal airport and seaplane base.

Including the approaches and the tunnel on Yerba Buena Island, the bridge will be more than eight miles long, more than four miles of which length will be over water. The bottom of the bridge will be 218 feet above high water. Seventy thousand eight hundred miles of wire, or nearly enough to go around the world three times, is used in the cables of the suspension part of the bridge. The wire is of the strongest kind of steel. There are more than 17,000 strands in each cable.

On the east end of the bridge, the approaches spread out like a fan, to serve the cities of Oakland, Berkeley, and Alameda.

Greatest Single Construction Project in the World

This bridge, which President Franklin D. Roosevelt declared to be the greatest single construction project on earth, is wholly a California project, although it is financed by the United States government. It is built by the California Toll Bridge Authority, of which Governor Frank F. Merriam is chairman. Earl Lee Kelly of the California Department of Public Works has been the one under whose direction all the plans were worked out.

Artist's conception of the completed San Francisco-Oakland Bay Bridge. The site of the Golden Gate International Exposition is shown on the left of Yerba Buena Island.

The Reasons Why These Great Bridges Were Built

It was not for the purpose of astonishing the world that these bridges were built, it was because they were necessary to the welfare of the people of San Francisco and Oakland and other nearby cities, and also of the people of northern California and of central California.

San Francisco was so bottled that it could not expand as it should expand. And all of northern and central California were bottled away from San Francisco, to some extent. The never ending stream of visitors and of commerce on the Redwood Highway had to detour to pass through the West's greatest natural gateway to the world. These bridges not only complete California's great highway system but put San Francisco directly on the main highways by land as well as by sea.

In southern California, not long ago, it was shown how making a single highway easier to travel may affect a great city. The highway between Los Angeles and Bakersfield known as the Ridge Route was well paved but was full of turns and twists. When its route was changed so that there were few turns and twists, compared to the number existing before, the highway was much more inviting than it had been. Then many visitors who formerly had gone to the north went to Los Angeles, and much business followed the same route.

The $112,000,000, which the Golden Gate Bridge and the San Francisco- Oakland Bay Bridge will cost, will be only a small part of the money which will be spent as a direct result of the bridges. Tens of thousands of new homes will be built in the communities made more accessible, or easier to reach. Hundreds of new business houses will have to be built to serve the growing

population in those areas. Thousands of workmen, drawn into the San Francisco Bay area by the work being done there, will become permanent residents.

Every visitor to California, from other parts of the United States or from other parts of the world, will want to see the wonderful new bridges. Trade from many foreign countries will be drawn to San Francisco and Oakland because the bridges make those cities far better centers from which to distribute goods than they were before. Trade from nearly all of the northwestern states will flow over them, to be distributed to other countries.

So it can be truly said that San Francisco, Alameda, and the northern counties have bridged their difficulties and are entering on a new era of progress and prosperity.

HOLDING BACK THE OCEAN AND MAKING RIVERS RUN UPHILL

THE CENTRAL VALLEY PROJECT

Map showing major features of the Central Valley Project

The Central Valley Project

The Completion of the Central Valley Project Will Hold Back the Ocean and Make Rivers Run Uphill

There are two things which most of us will say are impossible, without even stopping to wonder if they are. We imagine it is impossible to push back the tides of the ocean or make a river run backward. When California found it necessary to do those things in order to save 800,000 acres of productive lands, together with the business and property investments of nearly 1,000,000 people, those things ceased to be impossible. Work now under way on the Central Valley Project will accomplish both those results.

The Central Valley Project is intended to overcome not only one but many of the water problems of an area larger than many states. This area is 500 miles long and ranges from 40 to 100 miles in width. In some parts of that area there have been terrible floods because of too much water. In other parts of it there is drought which would result in the abandonment of valuable farm lands if it were allowed to continue. In still other parts of it the decreased flow of streams has allowed salt water from the ocean to flow in. It is doubtful if any other state, nation, or private company ever undertook such a varied and challenging program of water control and distribution.

Steamboats Ply the Sacramento River

When Spanish colonists were choosing lands in California the Sacramento River was a noble stream on which the comparatively small ships of that time could sail. However, at that time the Sacramento spread out like the Nile in flood seasons.

The country surrounding Sacramento is very flat and the river sometimes spread so wide, below its junction with the American River, that one could not see across it. In Sacramento today one may see many old houses built so that the whole household could move upstairs if the lower story was flooded.

Long ago steamboats took the place of ships on the Sacramento River and they still ply up and down the river. It was on the Sacramento River and with Sacramento River steamboats that the motion picture, "Steamboat 'Round the Bend," recently was filmed. The scenes pictured are supposed to be on the Mississippi River, but when the Sacramento is full of water it easily may be photographed so that it looks like the great Father of Waters.

The Sacramento River still is navigable for 225 miles when it is full of water. The San Joaquin River also used to be navigable for about 200 miles but at present it is navigable only in its lower reaches. The Sacramento is the largest river wholly within the State of California.

California Rivers Are Not Long But Carry Great Flow of Water

Most of the rivers of the Central Valley are not long. They rise in the Sierra Nevada and quickly find their way to the sea. When heavy and continuous rains fall in their enormous watershed, or when the snows in the mountains melt with unusual rapidity, the floods which come rushing down them well may strike terror to the hearts of those whose homes or farms lie near by.

It was through respect for those floods that Sutter's historic fort was set well back from the Sacramento River. There was also a pioneer village called Sutterville which was set on high

ground away from the river. But after Monterey, Benicia, and San Jose had served briefly as capitals of the American state of California, it was decided to locate the capital at Sacramento. The state capital was then practically in the center of population and the most accessible large town in California. At that time very few Californians traveled by road. The ocean and the navigable rivers were the main routes of travel.

The people of San Francisco and the coast were within easy reach of Sacramento by water and so were the people who lived on all the streams flowing into the Sacramento River. Most of the remainder of the population of the young state was within reach of the capital by land too, as southern California then

Destructive and costly waste of California's greatest natural resource. This flood scene of March, 1928, shows the Feather River which has covered valuable farm lands after breaking through a levee.

was but thinly populated. In short, Sacramento was selected as the capital city of California for much the same reasons that Washington was selected for the site of our national capital. At that time most of the Californians considered southern California about as far away and undeveloped as Alaska now seems to the people of the United States.

When Sacramento became the capital it began to grow rapidly. The great fertile valley produced most of California's food. It was the city from which the gold miners set forth to prospect the mountains. More boats sailed from San Francisco to Sacramento then than sailed from San Francisco to all other parts of the world.

A view of the Feather River in 1931, near the flood scene of 1928 shown on page 69. The river became totally dry and left 4500 acres of highly improved lands without irrigation water.

Floods Have Been a Menace to Sacramento Since Capital's Earliest Days

Naturally, the city of Sacramento grew down to the water's edge. The river was California's greatest highway of commerce and the time saving Americans preferred to run the risk of being flooded out rather than establish their homes and places of business an hour or two hours away from it by horse-and-wagon travel.

For many years parts of California's capital city were flooded frequently until giant levees were thrown up around the city to keep the floods out. The city now nestles in the elbow created by the junction of the Sacramento River and the American River. Though the United States government has spent a great deal of money to keep the river navigable and to prevent floods, there still are 800,000 acres of the Sacramento Valley which annually are in danger of being severely damaged by flood waters.

Driving from Sacramento to Davis you cross a causeway extending miles beyond the river. It is there because those miles of land are flooded year after year, and the highway has to be lifted up on the causeway to be safe from floods. If you drive down the river road from Sacramento to San Francisco you will see that in many places the highway is on dikes. Dikes and canals are so common there that the area sometimes is called "Little Holland." Even in Sacramento and beyond it one sees dikes.

If it were not for those dikes the annual flood damage to the Sacramento Valley would be far more serious. However, floods which menace 800,000 acres, including some of the most productive land in California, are serious enough.

If the American River and the Sacramento River ever should flood at the same time there would be terrible loss of property and probably loss of life in the valley. Fortunately, however, floods from these two great streams have not come in full force at the same time, because heavy rain storms on the watersheds of both rivers have not occurred at the same time.

Ocean Tide Reaches One Hundred Miles Beyond the Golden Gate

The reason the danger of floods in the Sacramento Valley is so serious is that the valley is as flat as a griddle. When the Sacramento River was California's greatest avenue of travel it was a greater river than it is now. Wherever hundreds of thousands of people settle along the banks of a river the river shrinks. Those settlers must either divert the water of the river for their agricultural and domestic uses or must divert other waters which would flow into the river.

The Sacramento and San Joaquin rivers used to rush down to the ocean with such a mighty flow that they entered Suisun Bay like a sort of Gulf Stream, forcing back the salt water of the bay. As the flow of these streams dwindled, however, due to upstream diversions, the salt water from the ocean has replaced the fresh river water in Suisun Bay and the delta channels.

This inflow of salt water during drought seasons holds back the waters of the Sacramento and San Joaquin rivers, and the tide is noticeable as far inland as Sacramento and Stockton, almost 100 miles from the Golden Gate. Under these conditions salt water penetrates far upstream into the delta channels.

Before so many people lived along the Sacramento and San Joaquin rivers their flow was so strong that settlers near the coast

of Suisun Bay, in Contra Costa County, could pump fresh water out of the bay. That was because the strong flow of these rivers held back the sea water. That is not at all unusual. The most powerful of all rivers, so far as records go, is the Amazon River in South America. It flows into the ocean with such force that its course can be clearly traced for many miles, and it is said that fresh water may be found in the current as far as 200 miles from shore.

The Sacramento and San Joaquin rivers have no such flow as that, but during great floods fresh water has been found down as far as the Golden Gate. Before so much of the river water was used, Suisun Bay was practically a fresh water bay during most

Celery production on Sacramento-San Joaquin Delta lands, irrigated from the lower reaches of the two rivers where salt water is encroaching

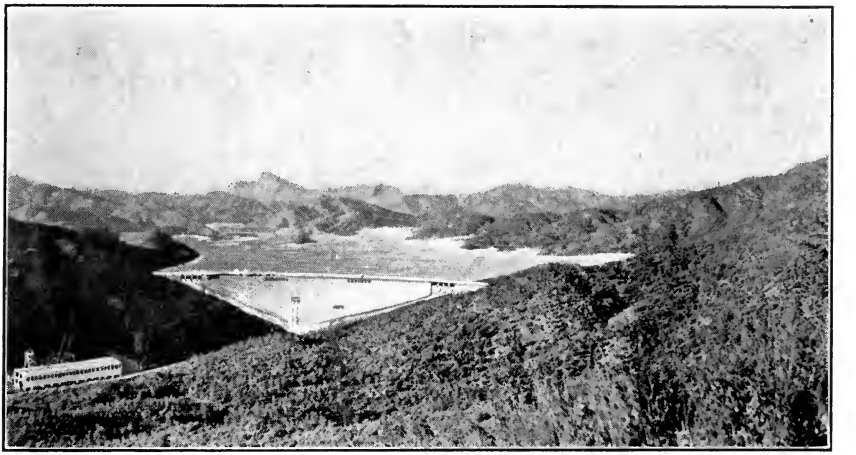
of the year. Even now when winter rains or melting snows in early summer send floods rushing down the Sacramento and San Joaquin rivers, the fresh water holds back the sea water. It is when the dry season comes that salt water is a serious problem in the upper bay and delta areas.

It has been becoming a greater and greater problem for years. Counting on fresh water from the river and the bay, an increasing population there has made important industrial and farming developments. Now the salt water invasion is so serious that the water in bay and delta channels is unfit for irrigation, and for industrial and commercial use during a considerable portion of the time.

Looking up the Sacramento River toward the Kennett Dam Site

Engineers Learn Important Lesson from Mother Nature

So the engineers have simply learned a lesson from nature. If the fresh water of the Sacramento and San Joaquin rivers used to hold back the salt water when the flow was greater it can hold it back again if the flow is again increased and held at a certain standard. Navigation and irrigation also will be greatly aided by what the engineers call a normalized flow.



Artist's conception of Kennett Dam. This huge structure, 420 feet in height, will be constructed on the headwaters of the Sacramento River to store flood waters and control the river flow for power development, navigation, irrigation, and industrial use.

Therefore, they have planned a great dam at Kennett on the upper Sacramento which will hold back the floods in those seasons when there is too much water. Three million acre-feet of water, or enough to cover 3,000,000 acres a foot deep, can be stored behind that dam. That would be enough water to cover the city of San Francisco 112 feet deep.

By holding back that water in wet seasons, the danger of floods, which have been a menace in the Sacramento Valley ever since the first Spanish settlers located there, will be practically ended. By drawing on the great store of water behind Kennett Dam in dry seasons, the flow of the Sacramento River can be kept up to the point the engineers consider necessary for irrigation, navigation, and holding back the salt water in Suisun Bay.

That normalized flow will supply enough water to keep the delta fresh, will provide ample irrigation for half a million fertile acres, and furnish a new supply of fresh water to the Contra Costa Conduit for industrial and agricultural use in the Suisun Bay district. It also will enable the engineers to make the San Joaquin River "flow backward."

How a River Can Be Made to Flow Uphill

The old saying that you cannot make water run up hill is not precisely true. With powerful pumps you can make water run the way it is pumped.

California's state water plan, of which the Central Valley Project is the backbone, has proceeded on the theory that nothing which has to be done is impossible. The Sacramento Valley and the San Joaquin Valley are practically the same valley. Together, they extend nearly 500 miles and are often referred to as the Great Valley. There is no range of mountains or hills to separate them. There are great differences between the northern and southern halves of that area. In the northern part of the Sacramento River drainage basin the annual rainfall averages 60 to 70 inches, while in parts of Kern County in the southern end of the San Joaquin Valley, the annual rainfall averages only from 5 to 10 inches.

There are 400,000 acres of productive land in the San Joaquin Valley which are facing ruin for lack of water. Ranchers who used to get water from wells which filled to within 15 feet of the surface now have to pump water from a depth of more than 200 feet from those same wells. The water levels in many of them have lowered as much as 20 feet in a single year in the last few years. Many wells have gone dry.

Orange groves near Navelencia in San Joaquin Valley. The grove on the left is dead, and the grove on the right is receiving barely enough water to keep it alive and produce a small crop.

Water pumped from such great depths is bound to be expensive. What is worse for some of the ranchers, however, is that there is not enough of it. It is clear that unless Kern and Tulare counties get much more rain and stream flow from the mountains than they have been getting in recent years, much fertile and

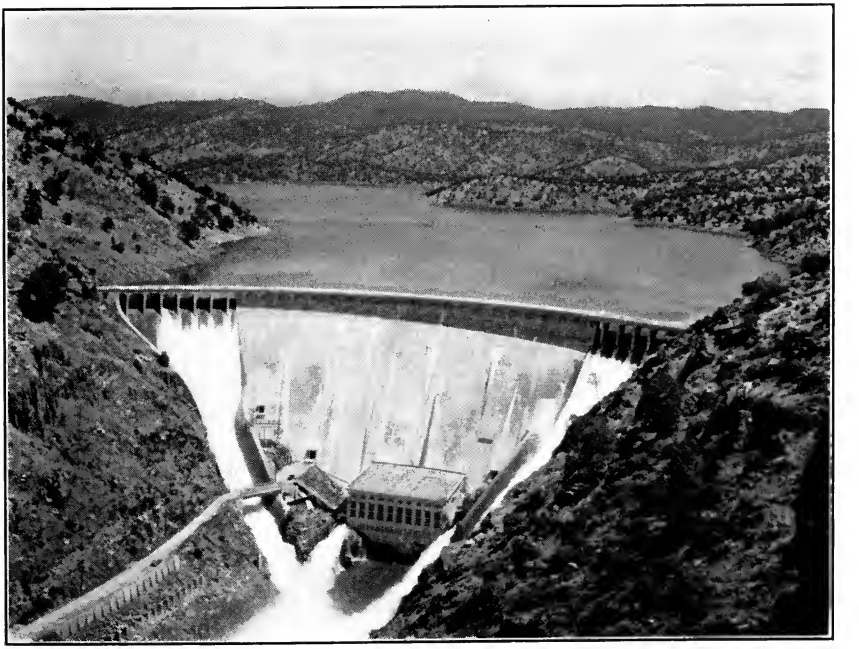
productive land will be lost and the prosperity of the entire San Joaquin Valley wiped out if water is not provided from other sources. Even a cycle of greater rainfall would not provide security for the valley because the water supply from normal sources is deficient. Another period of dry years would make the situation desperate indeed.

In short, if California did nothing to correct that situation the terrible dust storms which have created such havoc in the Middle West soon would be blowing away the top soil of great stretches of land in California. Then the prosperous and progressive cities, which depend on the products of those areas for food and for business, would dwindle away as the ghost towns of many old desert and mining districts have dwindled away.

Courtesy of Frank Adams

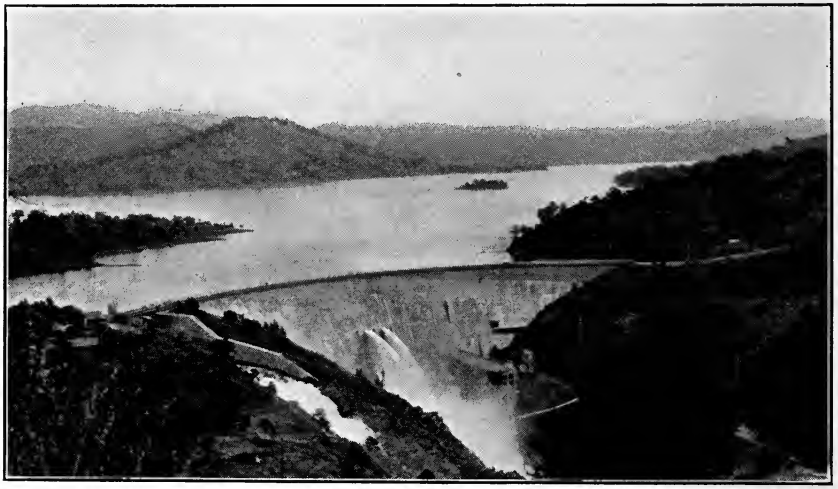
A portion of an orchard in southern San Joaquin Valley abandoned because of the failure of the underground water supply

But California is not going to sit idly by and see that happen. The California spirit will not permit it. The engineers of California's Department of Public Works have looked north and south and east and west. They have seen that in some areas there is too much water while in others there is too little, but that if all the water of the state can be divided more equally there will no longer be floods in one region and drought in another. California is the one state which has thoroughly worked out a water plan to serve all of its citizens.



Exchequer Dam and Power House on the Merced River. The water stored is used for generating electricity and for irrigation of land in the Merced district.

By damming the San Joaquin River at Friant, enough water can be stored to supply two important irrigation canals to serve the southern San Joaquin Valley but not enough to supply the water needs of the central and northern parts of the valley. Therefore the engineers have planned to borrow water from the Sacramento Valley. Pumping stations all along the San Joaquin River will actually keep water from the Sacramento River flowing up the San Joaquin Valley for a distance of 150 miles. By this means the San Joaquin River, though deprived of most of its own water by diversion from Friant Reservoir through the Madera and the Kern-Friant canals, will have enough water for the lands served in the central and northern San Joaquin Valley. Furthermore, dams placed in the river at each pumping station where the water is lifted can be equipped with navigation locks to make the river navigable again for steamboats.



Don Pedro Dam of the Turlock Irrigation District

California's State Water Plan First Visioned in 1891

We have seen that the Central Valley Project is the central part of the great water plan worked out for the whole state. That plan is so remarkable and unusual that we should know something of its history. It was Colonel Robert Bradford Marshall, then with the United States Geological Survey, who first visioned a state water plan for California. Colonel Marshall came to California in 1891. He had been in Colorado, where he had seen the benefits which might result from irrigation, and was struck by the fact that a great deal of California water was going to waste in the ocean while many

Melones Dam and Reservoir on the Stanislaus River. The stored water is released for the development of power and then used for irrigation in the San Joaquin Valley.

areas in the state were suffering for lack of water. He traveled over the entire state by mule team and buckboard. His survey showed that millions of acres in the Sacramento, San Joaquin, Santa Clara, Livermore, and Concord valleys were arid and unprofitable for lack of water, and that enough water was going to waste to cover most of this land to a depth of three feet annually. He asserted that the United States government would be justified in spending $750,000,000 on a great California water plan which would not only irrigate the arid lands but provide water for the cities of Los Angeles and San Francisco, as such a plan would enrich the state more than $6,000,000,000.

Typical headgates of an irrigation system where water is diverted from the stream to the canal that carries it to the land

In 1919 Colonel Marshall announced his plan through the newspapers and campaigned for it before the voters of the state, but it was defeated. The Marshall plan, however, was the forerunner of the present state water plan. One of the most important single features of the Marshall plan was the diversion of Sacramento River water into the San Joaquin Valley, and that is also an outstanding feature of the Central Valley Project.

Colonel Marshall was unable to get either the United States government or the State of California to adopt the great plan he outlined but he convinced so many people that something of the kind was necessary that in 1921 the California Legislature asked for a report. State Engineer W. F. McClure was instructed to make an investigation and prepare a comprehensive plan for complete development of all waters in the state. The work was carried on under the direction of Paul Bailey, who later became State Engineer. A series of valuable reports was prepared giving an inventory of all the waters and agricultural lands within the state, and submitting a preliminary comprehensive plan of development that would secure the greatest public benefit.

Additional appropriations were made by the Legislature in 1925, 1927, and 1929 to extend the investigations and perfect the plans of the 1923 report. Part of the 1925 appropriation was to repay funds advanced in 1923 by the San Francisco and Los Angeles chambers of commerce. Investigations were carried on by the State Department of Public Works which culminated in a report to the 1931 Legislature. This report, in 12 volumes, gives in detail for the entire state a complete inventory of its water resources, an estimate of water requirements, an engineering plan for the development of the water resources for all beneficial uses, and the units which should be first constructed to meet

the immediate necessities. The Central Valley Project was recommended for the Great Central Valley when and if funds could be provided for its construction. This report was prepared under the general direction of State Engineer Edward Hyatt, with A. D. Edmonston, Deputy State Engineer, in direct charge.

The next task was to obtain funds for its construction. State Engineer Hyatt and representative citizens of the Sacramento and San Joaquin valleys went to Washington, D. C., and presented their case before federal departments, asking for federal financial assistance on the basis of national interest in flood control, navigation, and irrigation. These departments were informed that the project would be a national asset and the entire nation would suffer if it were not constructed.

All of the United States Needs California's Fruits and Vegetables

It is a recognized fact that California is America's main source of supply for lemons, raisins, apricots, prunes, dates, figs, olives, almonds, canning asparagus, canning spinach, oranges, peaches, walnuts, and many fresh truck crops. The State Engineer presented figures and estimates to Congress to prove that if no aid were given to the Great Valley, the direct loss would be $30,000,000 a year and the indirect loss would be far greater. From that one valley come nearly one-fourth of America's supply of commercial vegetables and more than three-fourths of the country's commercial grapes, raisins, and dried fruits. It was estimated that the value of business created outside the state by the movement and sale of the products of the Great Valley reached $300,000,000, as refrigeration and transportation alone totaled $160,000,000. Those figures represented the totals for years, but it was conservatively estimated that if that great supply of food for the nation were

allowed to suffer greatly, the loss to the nation outside of California would be at least $18,000,000 a year. With the direct loss of $30,000,000 a year inside the state and the paralysis of business, which would occur in all the cities and towns counting on that rich agricultural area for support, and all the lines of business near and far which were affected by it, the total loss would be great enough to make all of the United States suffer. Housewives in Chicago and New York, where fresh vegetables cannot be raised the year round as in California, would be grieved every day by the scarcity of fresh, canned, and dried vegetables and fruits. When you realize that 95 per cent of the whole world's supply of canned asparagus, to take a single item, comes from the Delta region of California where the Sacramento and the San Joaquin rivers flow into Suisun Bay, you realize how important the total of all the products of the Great Valley must be to the whole United States.

Central Valley Project Not Planned to Create New Farming Land but to Protect Nation's Food Supply

The federal government was asked, therefore, to do something it had never been asked to do before. Most of the great irrigation projects of America were designed to convert desert lands into profitable farming country. In this case, however, the State of California was asking the federal government to come to the rescue of the greatest producing farming area in America. The main purpose of this great enterprise is not to put new land under irrigation but to save going concerns and to prevent the dwindling away of an area with a population of nearly 1,000,000 people and investments of many hundreds of millions of dollars. In that area are more than 3,000,000 acres of irrigated land, or over 60 per cent of the irrigated lands of the state.

The evidence the State Engineer presented to the federal government was so convincing that the Bureau of Reclamation, the Department of Agriculture, and the War Department approved the plans for the project and recommended federal financial assistance. These federal agencies have spent large sums in the investigation of the project. Private citizens, companies, and communities have also contributed substantially in furthering the project. The state has spent close to $1,000,000 for surveys and plans. Those surveys have shown that three-fourths of the water supply of California is in the northern one-third of the state, while three-fourths of the requirements for water are in the southern two-thirds of the state. At Redding there are from 30 to 50 inches of rain a year, while there are parts of Kern County which receive as little as five inches of rain a year. Yet there is more farm land in Kern County than in any other county in California, with Fresno County ranking second. Much of the irrigable land in the San Joaquin Valley has been made productive by water from wells. Now many of those wells are failing. If this is allowed to go on the result will be abandonment of farms.

When we remember that steamboats used to ply the San Joaquin River as far as Mendota but now can navigate only in the lower reaches of the river, we get some idea of how the water supply of the territory through which the river runs, has diminished. When the country was very thinly populated there was enough water for all the uses of the people and the wells put down here and there found plenty of subsoil moisture to draw on. But when hundreds of thousands of people drew on that subsoil storage of water, and river water was taken both for irrigation and household purposes, there simply was not enough.

Gold Mine Prospectors Showed the Way to Agricultural Riches

The miners of the California gold rush showed California the way to become the greatest of all agricultural states. When the miners came they were men of bold and adventurous spirit. They had to have water for placer mining so they diverted water from the nearest stream. In effect, they created little canals, along which vegetation sprang up and became luxuriant. Soon everyone knew that along those canals many things grew more rapidly and more successfully than they grew anywhere else.

Although dry farming was the general practice in California until 1885, a small amount of irrigation had been relied on for some purposes ever since Spanish days, and the prospectors' example of stream diversion was thoroughly understood by everybody. Therefore, as soon as rainfall failed to meet their needs, the farmers of California turned to irrigation.

It is the failure of the natural available sources of water for irrigation to meet the vast agricultural needs of California that makes necessary the diversion of water from the Sacramento River to the agricultural land in the San Joaquin Valley.

The federal government already had recognized its responsibility to California. In 1910 it had appropriated money for dredging the mouth of Sacramento River. In 1917 it appropriated $5,600,000 as the government's share of the Sacramento Flood Control Project and in 1928 increased the amount to $17,600,000. The great Central Valley Project, however, called for the expenditure of $170,000,000. It was a difficult task to persuade the federal government to advance that much money to California for this project.

Every passing year, though, made the situation more desperate and in 1931 Governor James Rolph issued a message on the water problem. In 1932 a committee of United States senators visited California to investigate the project, following a resolution introduced by Senator Hiram Johnson.

Four water committees of the State Legislature, three of which were lead by Senator Bradford S. Crittenden, intensively studied and carefully reported on the water problems of the state over a period of five years, and recommended legislation for their solution. The activities of these committees finally resulted in the passage of the Central Valley Project Act of 1933. Although held up by referendum, the act was approved by the voters of the state on December 19, 1933, and became a law on January 13, 1934. This act created the Water Project Authority, composed of the Director of Public Works, Director of Finance, Attorney General, Controller, and Treasurer, all officials of the state. The State Engineer is executive officer of the Authority.

It was the Emergency Relief Act of 1935, however, which made possible the initial financing of the Central Valley Project. This project, which California had needed for thirty years, would put 25,000 idle men to work. On September 10, 1935, President Franklin D. Roosevelt authorized the transfer of $20,000,000 from the Emergency Relief Fund to the United States Bureau of Reclamation. That amount later was reduced to $15,000,000, which was more than enough for all the work that could be done the first year. Walker Young, the government engineer in charge of construction of Boulder Dam, was placed in charge of this project for the federal government, working in cooperation with the State Department of Public Works and the Water Project Authority of the State of California.

Nine Important Purposes of the Great Central Valley Project

The Central Valley Project has nine main objectives, as follows:

1. The improvement of navigation on the Sacramento River.
2. The improvement of navigation on the San Joaquin River.
3. Flood control on the Sacramento River.
4. Flood control on the San Joaquin River.
5. The preservation of 400,000 acres of farm land in the upper San Joaquin Valley.
6. The preservation of 400,000 acres in the Sacramento-San Joaquin Delta.
7. Correcting deficiencies in irrigation in the Sacramento Valley above Sacramento.
8. Restoration of fresh water for industrial and agricultural uses on the south shore of Suisun Bay.
9. The generation of hydroelectric energy.

Let us consider these great and necessary undertakings one by one. As to the first two objectives or goals, there was a time when steamboats plied the Sacramento River as far as Red Bluff and plied the San Joaquin River as far as Mendota. The engineers say that if most of the water now going to waste is saved, there will not only be enough for all the needs of the growing population in the Great Valley but enough to restore transportation to its former standard on both those rivers. There are places in the high Sierra, in the Sacramento River watershed, in which close to 100 inches of rain fall in the average year. It is that tremendous rainfall which now rushes down the Sacramento River during the rainy season, turning it into a terrific force for destruction. There is less rainfall in the San Joaquin watershed than there is in the Sacramento basin, but in the

mountains above Friant there often is from 30 to 40 inches of moisture a year, mostly falling in the form of snow. When that snow melts rapidly the San Joaquin River also turns into a torrent which is dangerous in places, and wastefully pours into the sea enough water to irrigate hundreds of thousands of acres.

Water transportation always has been the cheapest mode of transportation. Neither tracks nor paving are necessary. Wherever a navigable river leads to and from a great market the people are independent. They can use other means of transportation when they wish, but the river always is there for their use if they need it. No competing transportation dares to charge them unreasonable rates for fear of losing the bulk of their business to the steamboats. It is a fact worth noting that nearly all the great cities of the world are located on navigable water.

The engineers have estimated that the dam at Kennett will store enough water which now is wasted to normalize the flow of the Sacramento River, so that steamboats again may ply as far as Red Bluff. Besides that, enough water can be diverted from the Sacramento River, through the San Joaquin cross channel, into the San Joaquin River, and pumped up that river by a series of booster pumps, to make the San Joaquin navigable.

The Kennett Dam will save the waste waters of the Sacramento, Pit, and McCloud rivers and Squaw Creek, and will enable the country below it to use those waters as it needs them.

Kennett Dam and Reservoir is indispensable to the realization of all of the objectives to be obtained because it will furnish practically all the additional water supply required to be utilized for all purposes. For this reason it is called the "key unit" of the Central Valley Project.

The third objective also will be attained through the regulation of the flow of the Sacramento River made possible by Kennett Dam. The fourth will be assured by the Friant Dam, which will hold back the melting snows of the Sierra Nevada to form a beautiful lake instead of letting them roar away to the ocean as a destructive flood.

The fifth objective will be secured by the Madera Canal, the Friant-Kern Canal and the San Joaquin Pumping System.

The sixth and seventh objectives will be achieved by the normalizing of the flow of the Sacramento River.

The eighth objective will be accomplished by the Contra Costa Canal.

The ninth objective may be obtained by the building of a hydroelectric power plant at Kennett. The sale of that energy to farmers and to industries will provide an income which will apply on the bonded indebtedness. It has been estimated that the $170,000,000 of bonds for this great project can be paid off in forty years by earnings from the sale of electric energy, water, and other facilities made available by the project. Whether or not that proves true, the saving from flood and drought, from salt water invasion and wind erosion, and the vastly increased earnings of the Great Valley will pay for the project many times.

Will Make California More Prosperous and More Beautiful

The Central Valley Project will make California more productive, more prosperous, and more beautiful. It will create two great lakes, as Friant Dam will impound 400,000 acre-feet of water and Kennett Dam, 3,000,000 acre-feet. It will make the lives and property of 900,000 people safer. It will give employment

to 25,000 men for three years and will create new employment for other thousands for many years to come. It will save America from the necessity of going without the fruits and vegetables for which it depends on the Great Valley and the Delta region. Last, and perhaps above all, it will prove to the world that the California spirit still will not admit defeat.

It will prove to you boys and girls of California that things other people consider impossible are not impossible if we will attack them with courage and intelligence. The people of China have endured alternate flood and drought for centuries because they looked on such disasters as the law of nature and therefore unavoidable. The people of California may greatly admire the Chinese for their philosophy but it is not our philosophy. Here we believe that nature has placed all the materials for a better and happier world at our disposal and it is our duty to use them. We must not be like the man in the Bible who buried his talents in a napkin.

We have every right to be proud of California, for we are part of it. Yet we have no right to be proud of ourselves unless we are doing our part or preparing to do our part to carry forward the progress of California. It has been said also in the Bible that where there is no vision the people perish. There was not enough vision in ancient Nineveh and Tyre and Babylon, and they perished, great as their progress was for a while. So far there has been vision enough in California to meet every great emergency that arose. In only a few years it will be time for you who are boys and girls of today to show whether or not you can do your part in California's forward march. Now is the time to prepare.

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